A
SUPPLEMENT
TO THE
LADIES' DIARY,
FOR THE YEAR 1789.

Containing Dissertations on Eclipses, Transits of Mercury, and the Comet that is expected to appear this Year; with many additional Solutions to the Enigmas, Rebuses, Queries, and Questions, for which there was not room in the Diary itſelf; with ſome New Charades, and a Collection of eaſy Questions for the Exerciſe of young Tyros.

By the DIARY AUTHOR.

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BRITISH MUSEUM

SUPPLEMENT
TO THE
LADIES' DIARY,
FOR THE YEAR 1789.

VARIOUS ANSWERS TO THE PRIZE ENIGMA.

1. *A Sonnet to Fancy, by Mr T Woolſton, of Adderbury.*

COME, ſportive *Fancy*, from thy gay domains,
And chaſe the languor of my drooping muſe;
Drive from my breaſt cares, life-corroding pains;
And all thy heav'n-born raptures there infuſe.

Waft me to verdant fields and fragrant groves,
Where blooming ſpring in all its beauty ſmiles;
Where roſy health and pleaſure wing the hours,
And heart-felt joy each anxious thought beguiles.

Or ſoft, with *thee*, down ſome ſequeſter'd vale,
Unſeen, at eaſe, delighted let me ſtray,
Well pleas'd to catch ſome ſweet inſpiring gale,
To chaſe thoſe clouds that chequer life's ſhort day.

Lowly to *thee* my ſuppliant wiſhes bend;
Still guide my muſe, but ſtill be virtue's friend.

2. *Eugenio, on the Vanity of youthful Expectations.*

In life's gay morn, what vivid hues
Adorn the animating views,
By flatt'ring *fancy* drawn!
No ſtorms, with ſullen aſpect, riſe,
To cloud the azure of the ſkies,
No miſts obſcure the dawn.

With looks invariably gay,
Young expectation points the way,
To ever bliſsful ſhades,
Where odours ſcent the breath of morn,
Where roſes bloom without a thorn,
And muſic fills the glades.

Enamour'd with the diſtant view,
Youth thinks its fictious beauties true,
And ſprings the prize to gain.
His graſp the gay illuſion flies;
Experience thus the cheat deſcries,
And proves his hopes were vain.

The path of life, tho' flowers adorn,
Yet often will the rugged thorn
Amidſt the flowers ariſe.
Expect not then on earth to ſhare
Enjoyment unallay'd by care,
But ſeek it in the ſkies.

3. *By Miſs Louiſa Amelia Harpur, of Briſtol.*

Fancy, bright goddeſs, low to thee I bend;
To all thy viſions rapt attention lend;
You rule with boundleſs ſway the raviſh'd ſoul;
With tranſport bleſs us, or with fear controul.
Beauty and ſweetneſs in thy ſmiles appear;
Yet Gorgon frowns thy magic traits can wear.
In poliſh'd numbers Diary's page you grace;
A well-wrought veil there ſhades your lovely face.

4. *Juvenis Boxonienſis, to the Author of the Prize Enigma.*

Sweet ſinging bard, whoſe pureſt numbers flow,
True echo to your ſubject moſt divine!
Aided by ſenſe, theſe jointly ſerve to ſhew
Poſſeſſion, ere you preſs'd the ſacred Nine.

Whether you climb high Heaven's boundleſs ſpace,
Or through eternal ages fondly roam,
As Milton ſings of Mind, "'Tis its own place,"
And every human breaſt its native home.

Such boundleſs themes, howe'er, do well ſupply
Rich food, its high-born appetite to pleaſe;
Whether brought down from yonder azure ſky,
From earth's rich treaſure, or the wond'rous ſeas.

Hail, Richardſon, enforce thy favourite theme,
Nor may thy pleaſing numbers ever fail;
Explain, expatiate on this good ſupreme;
And thou, enraptur'd *fancy*, ever hail!

5. *Sylvia's Anſwer to the Prize Enigma.*

While buſy thoughts the mind employ,
Fancy preſents or grief or joy,
To nurſe or leſſen woe;

The lover, by my friendly aid,
Enraptur'd ſees his darling maid,
And pays the ev'ning vow.

Thy cheering beams delight the ſoul,
And aid its flight from pole to pole,
Or worlds beyond the ſkies:
So let religion fire the mind,
To caſt earth's fleeting joys behind,
And win the heavenly prize.

6. *By Mr William Crane, of Quadring, Lincolnſhire.*

Fancy, varying phantom of the breaſt,
By ev'ry mortal how art thou careſs'd!
In love, fear, hope, and joy, thou ſtrikſt th' mind,
Nay, ev'ry paſſion to thy power's confin'd.

7. *The ſame, by Miſs Sally Browne, of Honiton.*

How bleſt is my ſhepherd and I,
When roving along the gay green;
Where our *fancy* at eaſe we enjoy,
And Flora enlivens the ſcene.

When Strephon his paſſion declares,
My heart it beats pit-it-ty pat;
And he aſks if I'm willing to wed;
But I ſcarcely can anſwer to that.

Then he earneſtly preſſes again,
And vows he'll for ever be true:
So what ſhall I ſay to my ſwain?
I appeal, deareſt ladies, to you.

8. *Mr Francis Smith's Addreſs to Lady Diana.*

Hail, Lady Di. I'm pleas'd to ſee
Your buſineſs ſo increaſe,
To need a "hand-maid to the arts,"
To give your readers peace.

May Heav'n its pureſt bleſſings ſhow'r
On your devoted head!
And babes unborn may bleſs the hour
When Tipper's * plan was laid.

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* The ingenious projector, who began it in the year 1704.

Go on, chaſte dame, your path purſue,
With wit and learning fraught;
So every weak contending foe
Shall vaniſh like a thought.

9. *Amator's Sonnet to Miſs * * *, of Southampton.*

When abſent from the maid I love,
Deep anguiſh rends my breaſt;
The hours on leaden pinions move,
I loſe my peace and reſt.

The bow'rs no longer charm my ſight,
The groves no more look gay,
The world ſeems ſunk in endleſs night,
When dear Laurette's away.

Should ocean's billows ceaſe to roll,
Or leaves to deck the tree;
True as the needle to the pole,
My *fancy* doats on thee.

My conſtant heart can ne'er forget
The bluſhing charms of dear Laurette.

10. *By Miſs Polly Harriſon, of Wirkſworth, Derbyſhire.*

Kind Damon, if thou'lt conſtant prove,
How bleſt would be my days!
Imagination's ſportive wing
Should wanton in thy praiſe.

11. *The ſame, by Mr Wm Bearcroft, of Nawton.*

In Richardſon's harmonious lines
The prize in verſe majeſtic ſhines,
Tho' hid in dark diſguiſe:
Yet while we read his moving ſtrains,
Of Bethlemites confin'd in chains,
Fancy proclaims the prize.

Acknowledgments are alſo made to the following ladies and gentlemen, for their ingenious Anſwer of the Prize Enigma, viz. Amaris, Antonia, Rob Barwick, Eliz Bewley, Wm Boyer, I Burr, John Burrow, Caſtalio, T Cock, I Croſbey, Edw Davis, Rich Dening, Dunelmenſis, P Fidler, John Farey, John Fieldes, Mat Fleck, Wm Gale. A Gibbs, Joſ Grover, W H Hall, Rob Hendy, Thos Higham, John Jackſon, Ignoramus, Henry Mellanby, Joſ Nendick, Wm Patrick, G Potts, T R, Philip Ruſher, I E Strephon, J T. M T, I Townſend, John Ward, Rob Watkins, W Weatherill, Thos Whicker, Geo Wilcockſon, and Wilderotienſis.

ALL THE ENIGMAS ANSWERED.

1 Faſhion
2 Birds Neſt
3 Mill-ſtone
4 Air
5 Echo
6 Fir Tree
7 Envy
8 Night
9 Smoke
10 Diary and Supp.
11 Candle
12 *or Prize*, Fancy

1. *All the Enigmas anſwered by Eugenio.*

Form'd by *fancy*'s magic ſtand;
  See *Diarian* beauties riſe;
Pine-trees waving at command,
  Faſhion ſpreading all her dies.
Echo every call attending,
  Envy raiſing no alarm,
Smoke in curling ſtreams aſcending,
  Balmy *air*, and ſcenes that charm.
Night the *candle*'s uſe requiring,
  Neſts in myſtic ſhades conceal'd,
Supplement to fame aſpiring,
  Roaring *mill*—if right reveal'd.

2. *A* SPRING MORNING, *by Mr John Fildes, Schoolmaſter.*

Now awful *night* has left her ſilent reign,
And morn returns with all her lovely train;
What countleſs beauties in each ſcene unite,
To pleaſe the *fancy*, and to charm the ſight!
The *candle* glimmers in the darkſome *mill*;
The ſun is loſt behind an eaſtern hill;
The ſky is ting'd with many a glitt'ring hue,
And, lo! in *ſmoke* aſcends the ſilver dew:
The face of nature, *dreſs'd* in vernal pride,
A charming proſpect yields on ev'ry ſide.
Aloft in *air* the lark thrills out his lay,
Whilſt pretty warblers chant in ev'ry ſpray;
The verdant groves with melody reſound,
And diſtant *echoes* catch the dying ſound:
Now all is joy among the feather'd race,
And univerſal harmony takes place;
Save where on yonder *pine-tree* mourns the rook,
Whoſe ſallow *neſt*lings late the ſchool-boy took.
The lowly peaſants to the fields repair,
To till the ground, or tend their fleecy care;
Completely happy in their humble ſtate,
They *envy* not the riches of the great;

But bleſs'd with competence, with health, and peace,
Obſcurely thus they calmly paſs their days,
Till ſummon'd hence by death they mount on high,
To realms of never-ending bliſs and joy.
But hold—this will be thought too long I fear,
For either *Diary* or *Supplement* next year.

3. *The ſame, by Philomath, of Rotherham.*

When meek-ey'd morn, with radiant luſtre bright,
Diſpell'd the darkſome ſhades of gloomy *night*,
I, born on *fancy*'s airy wings, did ſtray,
To hail the beauties of approaching day;
Put on my *hat*, a morning's walk to take,
To view the feather'd tribe their *neſts* forſake,
And from the lofty *firs* their flight to take:
Their tender throats they poured forth in *air*,
That *echo*'d back harmonious to my ear:
Alas! thought I, what pleaſures they enjoy,
While *envious* cares the mind of man annoy;
His life revolves in one continued round,
And like the *mill-ſtone* to one centre bound:
Some variegated ſcenes may pleaſe his ſight,
Or *Lady Di.* and *conſort* give delight:
But as the *ſmoke* ſoon vaniſhes in air,
So does his life, a dream that's told, appear;
Or as a *candle* lighted does decay,
So, like that taper bright, he fades away.

4. *The* SEASONS, *by Failſworthenſis.*

How joyous and gay paſs the hours,
How wing'd with ſweet pleaſures they fly,
What birds in the woods and the bowers,
In melody ſeeming to vie.

Dame Spring in a garment of green,
The hills and the valleys hath dreſs'd,
All nature in tranſport doth ſeem,
As *wak'd* from a winter of reſt.

Next ſummer, in chaplet of flowers,
Comes forward with April apace,
Whoſe breath is compoſed of ſhowers,
With frownings and ſmiles in his face;

Whilſt May in ſoft pride ſheds her dew,
And *faſhions* her carpet around,
The ſtarling her *neſt* builds anew,
And *echoes* the *air* with her ſound.

Next autumn; in veſtment of brown,
Stalks ſtately to view the ripe grain,
And peace to each breaſt deals around,
Nor *envy* or ſpleen doth remain.

Then let me *ſmoke* out ſome retreat,
Where females of virtue and ſenſe
Ev'ry improper paſſion defeat,
And ſuch as ariſe can diſpenſe.

Miſs *Eyeton* and *Latham* I'd chuſe,
With *Gardner*, who ſhines in the north,
And *foxes* and *lap-dogs* refuſe,
As trifles not worthy my *thought*.

While thus all the winter is ſpent,
Quite free from contention and ſtrife,
Each *night* on good authors intent,
To fit us for happier life.

No beau of the *mill* ſhould come near,
Nor ſuch as a *Bridewell* deſerve,
But thoſe who religious appear,
And never from virtue do ſwerve.

Then let us not waſte precious youth
In *cooking* and needleſs employ,
But *lamps* trim with virtue and truth,
And ripen for heavenly joy.

5. *The ſame anſwered, by I E Strephon.*

Shall I, ye fair, a youth unknown to fame,
In your lov'd pages dare to ſhew my name?
I've often wiſh'd, yet full as oft have fail'd,
Conſcious defects ſtill o'er my wiſh prevail'd:
Encourag'd by your new extance of ſpace,
I'll this year try to gain the wiſh'd-for place.—

Where winding Wear in wide meanders ſtray,
By banks gay *dreſt* in all the pride of May;
Where the ſweet ſongſters, with their hearts elate,
Sing in ſoft accents to their *neſted* mate;
How ſweet to rove! when with ſuch ſoften'd ſound,
The *mill* ſounds plenty all the adjacent round.
The *air* ſo pure, ſo healthful and ſerene;
Replete with pleaſure all the ſylvan ſcene:
While ſportive *echo* mimicks every ſtrain,
That floats along the verdant vocal plain.

My friend Tom *match'd* with Sue, his ſocial mate,
Where happy tempers *envy* not the great:

Their time is ſpent in duty and delight,
Peace cheers the day, and pleaſure glads the *night*.
No *ſmoke* nor brawlings e'er their bliſs deſtroy;
She loves her huſband, ſhe's his only joy.
Their bleſt abode I freely much frequent,
Where we peruſe your *Di.* and *Supplement*;
By *taper* light, and to ourſelves retir'd,
We've every ſound and ſentiment admir'd;
Obſerv'd the *fancy* of the tuneful tribe,
What this and that in myſtic ſtrains deſcribe.

All theſe I ſhare.—Yet all the ſweets combin'd,
Can't ſooth the ſorrows of my madd'ning mind;
Whilſt doom'd, alas! the abſence thus to bear,
Of lov'd Alexia, nought my mind can cheer.
Then ſay, ſweet nymph, why Strephon's fervent love,
Shou'd thus ſuch long, ſuch painful abſence prove.

6. *The ſame, by Mr J Townſend, Aſſiſtant at Mr Hague's Boarding-ſchool, Northampton.*

Of erſt *Madam Di.* ſtood confeſt,
  Unrival'd in merit and fame;
But the truth is now ſtronger expreſt,
  Her new-made connections proclaim.

What yearly amuſement we find,
  Dreſt up with poetical art;
The charms of the Muſes combin'd,
  Sweet rapturous pleaſures impart.

One ſings of fair nature's delights,
  Reclin'd 'neath the fine *ſpreading trees*;
Another ſweet *fancy* invites,
  Pierian ſiſters to pleaſe.

Arts poliſhed forms ſome explore,
  A *mill* or a *neſt* is their ſong;
Like *ſmoke* from combuſtion they ſoar,
  Diſdaining the ruſtical throng.

The gloom of the *nights* long to cheer,
  A *candle* our ſtudies befriend:
Much praiſe to the editor here,
  A hint ſo illumin'd to lend.

May Dia, thy *envied* fame
  Still *echo* around in the *air*;
Thy new-*faſhion'd* partner retain,
  To pleaſe and inſtruct the gay fair.

7. *The ſame, by Miſs Emma Spencer, in a Letter from the Country, to a Friend in Town.*

DEAR FRIEND,
I now write from a charming retreat;
My villa's enchanting, in all points complete;
Quite free from the noiſe and the *ſmoke* of the town;
I *envy* no mortal; content is my own.
And, lo, I'm become a mere ruſtic in form!
No feathers or gauzes my hair now *adorn*;
My amuſements are too in a ſuitable ſtyle,
And to breathe the freſh *air* I walk many a mile.
So when meditation I wiſh to enjoy,
And *fancy*, my mind on paſt ſcenes would employ;
A grove of tall *pines* I minutely explore,
And to *echo*, believe me, can talk a full hour.
In the view of a torrent you know I delight;
Not the din of a cat'ract my ſoul wou'd affright.
I like not the murmuring, whiſpering rill;
But am much better pleas'd with the roar of a *mill*.
My garden's adorn'd with ev'ry choice flow'r;
There Flora has laviſh'd her elegant ſtore.
And to ſhew you I wiſdom and order commend,
And modeſt induſtry love to befriend,
In this ſpot, know, I've placed ſome *neſts* of fine bees,
Their labours inſtruct me, regale me, and pleaſe;
And when you ſhall deign to bleſs my retreat,
Their honey you'll own a moſt excellent ſweet.
This epiſtle, you'll ſay, is ſure wond'rous fine;
That in folly romantic I greatly outſhine;
But when by the ſide of a lone winter fire,
All theſe my gay viſions will quickly expire.
Peace, peace my good friend, a reſource I've in ſtore,
To beguile that drear ſeaſon, and baffle its pow'r;
A few choſen friends my parlour will grace,
From my manſion bright *fancy* the vapours ſhall chace,
And feſtive enjoyment, and innocent cheer,
Sweet muſic, wax *candles* our *nights* ſhall make clear.
And when in ſoft numbers our wit we'd engage,
In *Diary*'s volumes we'll turn every page.
Thus you ſee, my dear Ann, I've delights not a few,
So with love and much friendſhip I bid you adieu.

8. *Sylvia thus anſwers the ſame.*

Far from the ſcenes of *faſhion* here I ſtray,
And gladly welcome the returning May.
The feather'd choir have left their *neſts*, to raiſe
Their tuneful notes to their Creator's praiſe.

The whiſtling ploughman envies not the great,
His *nights* are undiſturb'd, his ſleep is ſweet;
He's *match'd* with Suſan, who repays his toils,
Pleaſes his *fancy*, and his care beguiles;
She lights his *candle*, makes his chimney *ſmoke*,
And bows her willing ſhoulders to the yoke;
Hies to the *mill*, returns, and makes her bread,
Leſt the laſt loaf be ſpent ere Roger's fed.
No *Diary*, *Supplement*, or Magazine,
They need to cheer the rural happy ſcene.
The " vital *air*, the cheerful light is given,"
To " nature's ſons the common gifts of heaven."
Suſan and Roger happy with their lot!
Then be my greater bleſſings not forgot;
O Sylvia! *echo* forth thy grateful ſtrains,
Let them aſcend to yon cerulean plains;
Superior bleſſings claim ſuperior praiſe,
Through every future moment of thy days.

9. WINTER, *an Elegy, by Mr R Weſt*.

Lo! dreary winter reigns—the groves are ſtill,
No muſic ſounds the faded meads among,
Save but the clack of yonder lowly *mill*,
And the wild notes of Damon's ruſtic ſong.

How ſoon (deſcending from the weſtern ſky)
The golden ſun withdraws his languid ray!
How long, his cheerleſs abſence to ſupply,
The twinkling *taper* ſheds the mimic day.

No more to hail the ſaffron-mantled morn,
The lark exulting *echoes* o'er the dale;
No more the plaintive *night*-bird from the thorn,
Tells the pale moon her grief-excited tale.

Ye Sylvan haunts! where fann'd by tepid *air*,
Erewhile the ſun-burnt hind retir'd to reſt,
What time the truant ſtripling ſought with care,
Amongſt your ſhades the neatly-*faſhion'd neſt*;

No longer vocal with the warbler's ſtrains,
No more array'd in robes of vivid green;
Around your bow'rs a ſullen ſilence reigns,
And murky vapours ſadden all the ſcene.

The *envious* blaſts favonian breezes yield,
The welkin lours, and furious tempeſts beat;
Scarce finds the peaſant, ſhiv'ring from the field,
Within his *ſmoky* cot a ſafe retreat.

Yet there (by fortune and by friends forſook)
A liſping train their kind protector hail;
Read the fond father in a placid look,
And thank the hand that deals the ſcanty meal.

Ye *match*leſs fair, who grace *Diaria*'s ſhrine!
While *fancy* paints the various ills that wait
Where merit droops, and where the virtuous pine,
Beneath the chilling frowns of adverſe fate.

O! be it yours to ſooth the pungent woe,
That ſpeaks in pale dejection's down-caſt eye:
" To bid the tide of ſorrow ceaſe to flow,"
To huſh the tender pleading of a ſigh.

And when the winter of old age ſhall end
This tranſient life—triumphant from the tomb;
May you to brighter—happier ſcenes aſcend;
Amidſt eternal ſpring to live—and bloom!

10. *The* WISH, *by Mr Geo Wilcockſon.*

The glorious ſun had ſunk beneath the weſt,
The ſoaring ſky-lark ſunk into her *neſt*,
The rattling *mill* had ceas'd its loud career,
And dying *echo* loſt herſelf in *air*;
That wand'ring *lamp*, pale regent of the *night*,
The glitt'ring ſtars above that ſhine ſo bright,
In *faſhion* glorious by th' Almighty made,
All in their orbs, omnipotence diſplay'd;
All nature huſht; ſecure from *envy*'s bane,
I *mus'd* on her the cauſe of all my pain,
Whoſe ſmiles alone my tortur'd heart can cheer,
And drive from thence the *gloom* of fell deſpair;
Then Heav'n invok'd, and all the powers on high,
This *match*leſs maid's eſteem I might enjoy,
Meet her embrace, and claſp her in my arms,
And ſee her ſmile ten times ten thouſand charms:
I aſk no more, nay Heav'n can't more beſtow;
If bleſt with health and her, adieu to woe;
Theſe but my lot, to thee, eternal King,
I ſhall ſing praiſe while I have power to ſing.

11. *Addreſs to Solitude, by Mrs Eliz Bewley, of Newby.*

Hail, mildly ſoothing ſolitude,
Companion of the wiſe and good,
Un*envy'd nights* with thee I'll ſpend,
And *candle*-light ſhall me befriend.
But when the morning-lights appear,
My *thoughts*, like *air*, refin'd and clear,

From *ſmoke* ſhall then break forth, and ſing,
To praiſe my *author*, God and king.
How *matchleſs* are his works diſplay'd,
And pleaſing when his law's obey'd.
The *fancy*'d robes that deck the fair,
Fall ſhort of what wing'd ſongſters wear,
Where *millions* build their *neſts* on ground,
While ſome in trees or rocks are found,
And ſongs and *echoes* chant around.

Beſides the foregoing, and the Anſwers in the Diary, the Enigmas were alſo ingeniouſly anſwered by the following ladies and gentlemen, viz. Amaris, Robert Barwick, Geo Beſwick, Wm Boyer, Rob Bretherick, Geo Brown, I Burr, John Burrow, W C, John Cairns, John Campbell, J Caſtalio, Joſ Cowing, John Craggs, John Cullyer, Rich Dening, Dunelmenſis, J Farey, P Fidler, Matt Fleck, Wm Gale, J Grover, W H Hall Eſq, Polly Harriſon, Joſ Hartley, Rob Hendy junr, Thos Herod, J Jackſon, Ignoramus, Wm Jones, Thos King, T W Leiceſter, Henry Mellanby, Thos Metcalfe, Joſeph Nendick, Thos Nield, Wm Patrick, Alex Rowe, Philip Ruſher, John Shakeſpear, Joe Sherwin, I Singleton, C—ll Sk—rr—tt, Francis Smith, Jas Spilling, Geo Stevenſon, and Rob Watkins.

ANSWERS *to the* REBUSES *and* CHARADES.

Rebuſes.	*Charades.*
1 Cook	1 Eyeton
2 Fox	2 Bridewell
3 Wed	3 Lap-dog
4 Helen Latham	4 Breaſt-knot
5 Jane Gardener	5 Starling
	6 Sunday

1. *The Rebuſes anſwered by Amaris.*

Let *Cook* for fame the globe encircle round,
And *Fox*'s ſpeeches with applauſe be crown'd;
Let William Boyer *Helen Latham Wed*,
In hopes with her a happy life to lead;
While I purſue a prize that's more divine,
And ſtrive to make *Jane Gard'ner*'s virtues mine.

2. *The ſame, by Mr John Cavill, of Beighton.*

Of *Cook* and *Fox* let Britains boaſt,
Or *Helen Latham*, Boyer's toaſt,

Whilſt I with S. and lovely *Jane*,
Trip to the church o'er yonder plain,
There to unite their hearts and hands,
In one ſtrong tye—in *wed*-lock bands.

3. *The Rebuſes and Charades anſwered by Mr Tho Eland.*

Laſt *Sunday* the *Starling* ſung ſweet in my ear,
As I walk'd, with a *breaſt-knot* to give to my dear,
And *lap-dog* I took her beſide;
Which bowing preſented, ſhe kindly receiv'd,
I whiſper'd my tale, which ſhe ſmiling believ'd,
And ſoon I'm to make her a *bride*.

Well come then, dear *Eyeton*, *Jane Gardener* come,
With you, dear Miſs *Latham*, to my *wed*ding, here's room
For you and Charles *Fox*, if he pleaſe:
We'll in mirth ſpend the day, and at night—huſh! no more.
The *Cook* has provided good things in great ſtore,
Plumb-pudding, roaſt beef, and fine cheeſe.

4. *The ſame, by Mr Geo Stevenſon, of Weſt Boldon.*

"Hope travels through."

By thee, oh! Hope, we're ſure to find relief,
And future proſpects ſtill aſſuage our grief;
Spurr'd on by thee, their ſwains all think to find,
Miſs *Eyeton* and *Jane Gard'ner* frank and kind,
With dear Miſs *Latham*; and that they may
In *Wed*lock's bands all join without delay.——
With *Breaſt-knot* trimly fixt, and penſive air,
On *Sunday* ev'ning, overcharg'd with care,
The maid walks out where *Starlings* chant the ſong,
While anxious doubts into her boſom throng,
That her falſe ſwain ſome happier nymph has led
To church, and now perhaps with her is *wed*;—
'Tis thine, ſweet Hope, kind to reverſe the view,
And whiſper to her, Damon ſtill is true.—
When patriot *Fox* a candidate did ſtand,
Thou always wert a friend at his command.
Led on by thee, *Cook* ſearch'd the ſouthern main,
And unknown regions ſtill he ſtrove to gain.
Ev'n giddy youth, in *Bridewell* who lament,
Repenting now, thou ſootheſt with content.

5. *The Charades, anſwered by Mr Robert Allanſon.*

Laſt *Sunday* Miſs *Eyeton* commenced a *Bride*,
And bleſs'd her fond lover, who long time had ſigh'd;
The maids who attended, had every thing new,
Their gowns of rich ſilks, and their *Breaſt-knots* of blue.

The *Starling* ſung ſweetly t'beguile the long day,
And her *Lap-dog* attended her all the long way.

6. *Mr Philip Ruſher, on the Purſuit of a Wife.*

In purſuit of a wife to his mind,
  Jack Lovemore advent'rous ſet out,
In hopes ſuch a fair one to find
  As would baniſh a new-riſen doubt:

For he'd lately been told by a friend,
  In whom he had us'd to confide,
That his life in a *Bridewell* he'd ſpend
  Ere he to the ſex would be ty'd.

To prove them, Jack therefore addreſs'd
  Miſs *Starling*, a finiſh'd coquet,
And oft for an anſwer he preſt,
  And many a ſmile did he get.

But ſoon from her manners he ſaw
  That none but herſelf ſhe admir'd,
Self-love was a guide and a law;
  So he made her his bow, and retir'd.

The next that approv'd his ſoft words,
  Was a lady of birth, paſt her prime,
Whoſe *lap-dogs* and monkeys and birds
  Engroſs'd the beſt part of her time.

One *Sunday* a viſit he made,
  She aſk'd him to ſtay and to dine;
To puſs the firſt cover was laid,
  And pug fill'd the glaſſes with wine.

Diſguſted he flew to a third,
  Poſſeſs'd of a fortune, and young;
Of her beauty on all ſides he heard,
  But the lady, alas! had a tongue.

Jack's patience was now almoſt tir'd,
  And all his philoſophy gone———
Miſs *Eyeton*, ſays he, I've admir'd,
  Her *Breaſt-knot*'s ſo neatly put on;

If this ſhould turn out like the reſt,
  Adieu then all thoughts of a wiſe,
I'll think that my friend did the beſt,
  To chooſe an old bachelor's life.

Various other ingenious Anſwers to the Rebuſes and Charades, beſides thoſe inſerted in the Diary and Supplement, were given by Meſſieurs Rob Barwick, Wm Bearcroft, Mrs Eliz Bewley, Juvenis Boxonienſis, Rob Bretherick, Geo Brown, I Burr, John Cairns, John Campbell, John

Craggs, John Cullyer, John Dalton, Richd Dening, John Farey, P Fidler, John Fildes, Matt Fleck, Wm Gale, Wm Gradidge, Toby Hamſborn, J Hartley, Rob Hendy, John Jackſon, Ignoramus, Wm Jones, T W Leiceſter, Geo Lodge, Joſ Nendick, Wm Patrick, Ptolemais, Alex Rowe, John Shakeſpear, Joe Sherwin, J Singleton, Francis Smith, J Walton, Tho Whicker, and Wildcotienſis.

ANSWERS TO THE QUERIES.

Query 1. *Anſwered by Mr Wm Bearcroft, of Nawton.*

It is proved by experiments on the air-pump, that no ſound can be propagated without air; and but very little in air much rarefied: on the contrary, it is proved by the condenſing engine, that ſounds are loudeſt in the denſeſt air, the quantity of ſound depending entirely on the degree of condenſation. Now the air is rarefied by the heat of the ſun in the day-time, and condenſed by cold in the night; whence the reaſon that ſound is heard at a greater diſtance in the night than in the day. And as to its diſtinctneſs, it is owing to the ſtillneſs of the air, which in the night is not diſturbed by the undulations ariſing from ſuch a confuſion of ſounds as in the day-time.

The ſame, by Mr Tho. King, of Lambert's Caſtle Hill.

The reaſons, I think, are obviouſly theſe.—It is well known that air is the medium of ſound; were there no air, there would be no ſound, nor a bell heard at the leaſt diſtance; as is proved by the air-pump. And as the air is condenſed, or rarefied, the more or leſs intenſe the ſound is.—There are alſo other reaſons: in the night, all is calm and ſilent, and we (perhaps often through fear) liſten with the more attention, being debarred the faculty of ſeeing diſtinctly in the night. In the day-time, the air is every moment full of ſounds of all ſorts, reverberating againſt one another, which diverſity of ſounds deaden each other. Therefore, ſound is not ſo diſtinct in the day, nor are we ſo attentive to it, as in the night.

The ſame, by Mr Geo Stevenſon, of Weſt-Boldon.

This depends on two cauſes.—Firſt, that in the day-time a greater number of ſounds are flying about, than at night, which, by daſhing againſt, and impeding each other, are made leſs diſtinct. The ſecond, and chief cauſe is, that the denſity of the atmoſphere is greater by night than by day, and therefore the ſounds are heard better: for if a bell be ſtruck in an exhauſted receiver, the ſound is not heard; but as the air is let in, the ſound is proportionally louder.

By Mr John Burrow, of Bolton-field.

Sound is louder in a denſe than in a rarefied medium, and the air is rarefied in the day-time by the heat of the ſun. Likewiſe the great number of birds and inſects in the day-time, by their motion, will cauſe an agitation in the air, it being a fluid, which ceaſes in the night. So that becoming more ſtill and ſmooth, ſounds are then heard more diſtinctly.

Query 2. *Anſwered by Mr John Dalton, of Kendal.*

That part of the kettle which is in contact with the water, will continually communicate its heat to the water, till this boils; and conſequently that part will never be much hotter than the boiling water. But the other part of the kettle will moſtly be much hotter, as metal is ſuſceptible of greater heat than water is: and the ſteam, riſing againſt it, will be continually diſſipated with a hiſſing noiſe, like to that made by immerging hot iron in water.

By Mr John Jackſon, of Hutton-Rudby ſchool.

The upper parts of a kettle heat, as well as the water; ſo that, when the water begins to ſimmer, as it is called, it riſes up againſt the hot ſides, and cauſes a hiſſing ſound; the ſame as a piece of hot metal will do, when gradually immerſed in either hot or cold water. And this hiſſing is more diſcernible in a tea-kettle, than in an open pan, becauſe the ſound is firſt confined under a kind of dome, and afterwards forced out of the pipe with the rarefied air, in a body of tone like a kind of muſical inſtrument: and the ſound is alſo ſtronger if the ſides of the kettle be furred, as a greater body of matter is then heated.

The ſame, by Mr John Cullyer, of Hingham.

The ſinging of the kettle is cauſed by the agitation of the water, quenching the heated parts of the metal near the ſurface of the water.

The ſame, by Mr John Craggs, of Hylton, Durham.

This ſound ariſes when the heat has ſufficiently penetrated through the bottom of the kettle, and begins to drive the air and water upwards againſt the heated ſides of the metal. In old kettles there is commonly a furr or ſediment collected on the bottom and ſides of the kettle, from the groſs particles of matter in the water, which cauſes a greater ſinging than in a new kettle.

Query 3. *Anſwered by Mr Wm Bearcroft.*

Mankind, according to Plato, were not originally divided in male and female, as at preſent, but each individual perſon was a compound of both ſexes, and was in himſelf both huſband and wife, melted down into one living creature. Afterwards, the male part was divorced from the female, and two imperfect beings made of the perfect compound one. Yet, notwithſtanding this diviſion, ſo lively is our remembrance of the happineſs we enjoyed in our primeval ſtate, that we are never at reſt in this ſituation; but each of theſe halves is continually ſeeking through the whole ſpecies to find the other half which was broken from it; and when they meet, they join again with the greateſt fondneſs and ſympathy. But it often happens that they are miſtaken in this particular, and take for their half what no way belongs to them; and the parts do not fit or join with each other, as is uſual in fractures. In this caſe, the union is ſoon diſſolved, and each part is ſet looſe again to hunt for its loſt half, joining itſelf to every one it meets by way of trial, and enjoying no reſt till its perfect ſympathy with its partner ſhews, that it has at laſt been ſucceſsful in its endeavours.

If we admit Plato's fanciful hypotheſis, the query may be anſwered in the affirmative: but when we conſider, though the heart of man naturally delights in liberty, and hates every thing to which it is confined; yet it as naturally ſubmits to neceſſity, and ſoon quits an inclination when there appears an abſolute impoſſibility of ſatisfying it:—that nothing is more dangerous, than to unite two perſons ſo cloſe in all their intereſts and concerns, as man and wife, without rendering the union entire and total:—that the leaſt poſſibility of a ſeparate intereſt, muſt be the ſource of endleſs quarrels and jealouſies;—we ſhall readily conclude, that a more eaſy attainment of divorces would be ſo far from contributing to the happineſs of the married ſtate, that it would be better if they could not be had at all. *See Hume's Eſſays.*

By Mr Wm Boyer, of Leyland Free-ſchool.

Were divorces to be procured at an eaſy expence, it would probably ſave the reputation of many a worthy lady: and, doubtleſs, there are thouſands of couples who, fearing the divorce, would ſo endeavour to pleaſe each other, as would make the marriage-chain hang as an ornament, rather than as an intolerable yoke. And if an immoveable hatred has taken place on either ſide, the ſooner they are parted, in my opinion, the better.

By Mr Rob Barwick, of Ringſtead.

If divorces were more eaſy to obtain, I mean if they could be obtained at a ſmall expence, ſo as to be had by the common people, I think it would be far from contributing to the happineſs of the marriage ſtate; nay, on the contrary, it would have the quite contrary effect: for, in that caſe, on any trivial jar between a married pair, a divorce would be ſued for, and a new marriage enſue; and after that another, and ſo on. So that there would be no conſtancy in that ſtate; and many would make diſputes on purpoſe to get rid of a diſagreeable partner.

By Mr Geo Stevenſon.

As divorces are allowed by the Chriſtian religion, and the laws of the land, to the higher ranks, and muſt free from great unhappineſs the injured party; if divorces could alſo be obtained at an eaſy expence, I think, it would contribute to the happineſs of the inferior ranks of mankind.——Lord Bolingbroke thinks, that in caſes of great diſagreement, or provocation in wedlock, divorces would be a happineſs if they could be obtained.

By Mr W Weatherill.

I think it almoſt impoſſible to give a deciſive anſwer to this query. For although, when it ſhould be known that divorces could be eaſily obtained, thoſe foibles, which commonly give riſe to domeſtic ſtrife, would be laid aſide; yet, if we conſider the capriciouſneſs of moſt men's tempers, it is eaſy to perceive that a woman, though never ſo aſſiduous in performing the duties of a wife, would be in continual dread of being abandoned, and falling a victim to the unruly deſires of a fickle huſband.

Mr James Williams ſays, that mutual forbearance being a principal ingredient in ſocial happineſs in general, and eminently ſo in matrimonial happineſs in particular; if divorces were more frequent, that amiable quality would ſeem to be leſs neceſſary, and conſequently would be leſs exerciſed; and therefore the happineſs of the married ſtate, inſtead of being increaſed, would be greatly diminiſhed.

And Mr John Jackſon obſerves, that if divorces could be more eaſily obtained, they would be productive of the worſt conſequences; for then, upon every ſlight diſguſt, the parties would be ſeparated; and if there had ever been a mutual affection, they would afterwards repent the raſh ſeparation, which would then confirm a more laſting miſery than all the little ruffles which their minds had before experienced in a marriage ſtate.

With many more anſwers to the ſame purport, which we muſt reluctantly omit for want of room.

Query 4. *Anſwered by Mr John Unwin, of Wirkſworth.*

Concerning this phenomenon, it may be obſerved, that the rocks, ſtones, &c. in which the toads were found enveloped, might probably be formed much poſterior to the creation of the world. Now it appears neceſſary, in order to reconcile or ſoften this ſeeming paradoxical query, to ſuppoſe a toad-egg formed, and impregnated by a male of that ſpecies, was floating among the fluids which compoſe the rock, and upon the evaporation of the ſuperfluous liquid, by ſome particular revolution, it became enveloped with the ſubſtance, and a ſmall vacuity being happily left in the centre of the rock, which exempted the fecundated egg from putrefaction, and left a ſmall circumambient atmoſphere, it preſerved the exiſtence of its vital principle, and rendered it unſuſceptible of external impreſſions.

Now, if we can preſerve the prolific virtue of eggs for many years, by a varniſh or incruſtation, by defending them from impreſſions of air and moiſture; it may reaſonably be ſuppoſed, that an egg will be ſecure in the centre of a rock; and we may conceive, that, in ſuch a ſtate of inactivity, the egg may ſubſiſt for thouſands of years without hatching; nor can we conceive how it can be hatched at all in ſuch a ſituation, unleſs by extreme degrees of frequently reiterated, or long continued warmth, occaſioned, I preſume, by the ſun getting nearer to it, or by ſome agitation of minerals in the bowels of the earth, which may probably be the cauſe of this animal coming to perfection, and ſuſtained, as the egg, by the ſurrounding moiſture in the cavity; though its life is, perhaps, but of ſhort duration.

The ingenious propoſer obſerves that, upon ſplitting the ſtone, the animal, being expoſed to the open air, has ſoon after died: I think, the different impreſſions it receives from ſuch a change, is undoubtedly the cauſe of its death.

The ſame, by Mr John Dalton.

It can hardly be expected, in the preſent ſtate of philoſophy, that a juſt and ſatisfactory account ſhould be given of theſe aſtoniſhing phenomena. The following conjectures have occurred to me on conſidering the ſubject: it has been found from accident, and related in vol. 64. of the Philoſ. Tranſ. that ſome ſnails, after being cloſely confined in a drawer, for fourteen or fifteen years, were afterwards brought to life again. From which circumſtance, I think, it cannot be deemed impoſſible, or even improbable, but that the ſame might have happened, had they been confined for four hundred or four thouſand years. Now, why may not toads have penetrated into marble, &c. when in a ſoft ſtate, and afterwards, the petrefaction going on, have been ſo firmly incloſed as not to be able to eſcape, if any efforts had been made for that purpoſe? Wherefore we may ſuppoſe that, being deſtitute of food, air, &c. the vital functions will continue ſuſpended, as in the caſe of the ſnails, till by accident being delivered from their impriſonment, they recover from their torpid ſtate.

The circumſtance of a toad found in the middle of the trunk of an elm, related in the Memoirs of the Academy of Sciences of Paris, for 1719, will not however be explicable on his hypotheſis.

By Mr J Croſbey.

Thoſe toads, when in embryo, or very young, may have fallen into ſome hole or crevice in the rock, out of which they have never been able to extricate themſelves again; and when the workmen have taken thoſe blocks from the quarry, the hole or crevice (which has either been grown over with graſs, or filled with mould by their uncovering the ſaid rock) has not been obſerved by them; ſo that, when the blocks have been taken from the quarry, and the toads found, they have cauſed great wonder to think how they got there.

By Mr John Jackſon.

At the time of the deluge, the conſtituent corpuſcles of the antediluvian earth were disjointed, and their coheſion perfectly ceaſed; and as the flood ſubſided, gravitation again took place, and ſhells, bones, and other bodies were mixed with matter of different kinds. Hence toad-ſpawn may be ſuppoſed to have ſettled in bodies which have concreted into ſolid ſtone, and in which the embryo might be hatched and ſuſtained till the time that it was found, when it preſently dies from the great change in its ſtate.

By Mr John Cairns.

This may be accounted for on this principle, that, as ſtones are generated from clay or earth, upon which toads live, the ſpawn of theſe reptiles might be incloſed in ſome of this earth, which in proceſs of time is moulded into ſolid ſtone; and through the pores of this matter the animal may be ſuſtained by the communication of water and air, ſufficient to continue its exiſtence.

By Mr John Burrow.

Toads always ſpawning among water, ſome of the water and the ſpawn together may have accidentally deſcended into uch cavities, and there become a living animal. And where there was a deſcent for water at firſt, there may be the ſame afterwards; and water being full of living creatures, ſeveral of which are viſible, even without a microſcope, this water will be ſufficient to nouriſh and ſuſtain the toad in that ſituation.

Query 5. *Anſwered by Failſworthenſis.*

The reaſon why the air appears or ſeems colder about ſun-ſet than after, is evidently this:—The ſun having withdrawn his rays, the air is deprived of its fire or heat, and the heat lodged in our bodies ruſhes out into the external air, to reſtore the equilibrium, leaving us in a chilly cold ſtate, which gives us the idea or ſenſation of greater cold than we feel afterwards: juſt as when we warm our hand, and ſlip it into cold water, the fire flies out of the hand into the water, and our ſenſation of cold, in that hand, is far greater than we experience from putting our hand, when cold, into the water. And that the air is colder at ſun-riſe, than before or after, is pretty evident from this: that the longer the fire is withheld from the air, the more denſe and cold this will be; for the leaſt degree of heat, is the greateſt degree of cold, which will be at ſun-riſe.

The ſame, by Mr John Burrow.

That the air feels colder before ſun-riſe than at any other time, is no wonder: for not only the abſolute degree of cold is greateſt at that time, but preſently after ſun-riſe we feel the ſudden change very ſenſibly from a cold to a warm ſtate of the air. But I cannot think that it is colder at ſun-ſet than any time of the night afterwards, but only that the change of the air, from warm to cold, is moſt ſenſibly perceived at that time.

By Mr John Cairns.

That the air feels colder at ſun-riſing and ſetting, than either before or after, is owing to the ſudden impreſſion his beams make in the morning on our bodies, or on leaving us ſuddenly in the evening: the ſame as a perſon very cold feels when ſuddenly going near a fire. And a perſon, at ſun-ſetting, is like one going from a hot fire to the cold air, who feels more acutely at firſt, than he will do afterwards. So that the perception, as to the evening at leaſt, is only relatively to our bodies, and not abſolutely in the air itſelf. The effect however on our bodies is the ſame as if it were, and therefore ſuch perſons as are expoſed the whole day to the external air, are moſt ſubject to take cold juſt at this period of time; and for this reaſon it is that gardeners ,an labouring men, will often put on their coat juſt at ſun-ſet though they may continue to work for ſome time afterwards; and that they ſeldom put their coat off till after ſun-riſe in the morning; experience having taught them theſe prudential cautions.

Query 6. *Anſwered by Mr John Dalton.*

The exiſtence of man in a future ſtate, reſts only on probability, from any ſyſtem of philoſophy hitherto known. Contemplative men of all ages, but more eſpecially ſince the modern improvements in philoſophy, might reaſonably imagine, that the Divine Being, whoſe bounty is not leſs conſpicuous than his power and wiſdom, would not have endued men with faculties capable of ſuch vaſt improvements, had they been deſigned to finiſh their exiſtence with this life. But notwithſtanding this, there might ſtill have been room for doubt, had we not been aſſured from revelation, that the preſent life is only preparatory for another of endleſs duration.

The ſame by Mr Wm H Hall Eſq, Barriſter at Law.

Plato, the ſon of Sophronius, ſublimely treats of the immortality of the ſoul, which he deduces from the appearances of nature, and the propenſities of man. His characters of vice and virtue are truly great—upon which he reſts in peace here—and a happy immortality hereafter. But if evil is committed, he aſſures the contrary.——Socrates's ſyſtem is pretty much the ſame.

By Mr J Walton.

As the moral attributes of God are ſuperior to the deſires and capacities of the ſoul, ſo that ſyſtem of divinity which treats of the wiſdom, juſtice, and goodneſs of God, muſt afford the moſt convincing arguments in ſupport of the ſoul's immortality. For as it is inconſiſtent with the juſtice of God to ſuffer the wicked to eſcape unpuniſhed, or the good to remain unrewarded; ſo the manifeſt and almoſt conſtant proſperity of the wicked, and the frequent unhappineſs of good men in this life, is a convincing proof, that there muſt be a future ſtate of exiſtence, where virtue and vice ſhall each obtain its proper recompence.

By Mr John Craggs, of Hylton.

Doctor Cheyne, at page 75, part 2, of his Philoſophical Principles of Religion, has treated this query in a plain and clear manner, and fully demonſtrates or proves, that as the immortal part of intelligent compounded beings is an epitome and image of the ſpiritual world, and as the Deity neceſſarily exiſts, therefore the ſoul of man, or ſpiritual part, muſt exiſt for ever; not neceſſarily of itſelf, but as being the image of him who exiſts neceſſarily, and having their being from him.

By Mr Jos Cowing, Writing-maſter, Newcaſtle.

Moral philoſophy, or that of the mind, gives us, perhaps, the moſt convincing proof of man's immortality, when we conſider man as to his moral faculties, the capacities of the ſoul, the knowledge he abounds with, the hope of immortality which ſupports the minds of virtuous men, the reproofs of conſcience, and the fears of futurity, from which wicked men are ſcarce able to free themſelves. All theſe may be conſidered as proofs, which make our immortality at leaſt probable, and are much ſtronger than any thing that can be urged againſt it.

For ingenious Solutions to the Queries, we are particularly obliged to Meſſieurs Rob Barwick, Wm Bearcroft, Wm Boyer, John Burrow, John Cairns, T Cock, Rd Cockrel, Joſ Cowing, John Craggs, J Croſby, John Cullyer, John Dalton, Rd Dening, Dunelmenſis, T Eland, Failſworthenſis, John Farey, P Fidler, W H Hall Eſq, J Hunt, John Jackſon, Thos King, Henry Mellanby, Alex Rowe, Jas Spilling, Geo Stevenſon, John Unwin, G Walton, R Weatherill, and James Williams.

To Mr Wm Bearcroft, in particular, we are obliged, not only for his very ingenious compoſitions, but alſo for his friendly and uſeful hints concerning the future conduct of the Diary and the Supplement, which we ſhall certainly avail ourſelves of, and have for that purpoſe made a beginning in the preſent New Year's works.

As we ſhall always be thankful to our contributors, for any hints of improvements they may communicate, ſo we ſhall be particularly ſo, at preſent, with regard to the nature and conduct of the Supplement to the Diary, which we have this year enlarged to three ſheets, being the ſame quantity with the Diary itſelf, though the price is continued ſtill the ſame as before, namely only ſix-pence. A few eaſy practical queſtions are alſo added this year, for exerciſes to Tyros; to try whether that may meet the approbation of the public, by whoſe opinion we ſhall always wiſh to conduct ourſelves in any thing that may be for the improvement of the Diary. Some other temporary things are alſo here added, which there is not room for in the Diary itſelf. And the Editor muſt repeat, that, having undertaken this Supplement, at his ſole riſk and expence, for the improvement of the Diary, and to oblige the more of his learned and increaſing contributors, by thus preſerving a number of their ingenious compoſitions from being loſt, for want of room to comprize them all in the narrow limits of the Diary; he hopes all friends of that uſeful and amuſing little work, will extend the knowledge and ſale of this Supplement, as much as they can, amongſt their acquaintances.

NEW CHARADES,

To be Anſwered next Year.

I. Charade, *by Mr Robert Richardſon.*

My *firſt* is a hindrance to all you can name;
The charms of my *next*, hear old Gripus proclaim:
My *whole*, honeſt Hodge without ſcruple allows
The means of procuring him horſes and cows.

II. Charade, *by Mr Thomas Woolſton.*

My *firſt*, from oriental climes convey'd,
  A ſwarthy ſtranger, to Britannia's ſtrand,
Here captivates the widow, wife, and maid,
  And few its faſcinating charms withſtand.

My *next*, of various forms and colours known,
  By art produc'd from metals or from clay,
The ſot purſues till his laſt mite is gone,
  Tho' full too oft I lead his feet aſtray.

My *whole* is always us'd to make my *firſt*,
  Where round the ſtreams in boiling eddies glide;
Come, all ye gentle belles, whene'er ye thirſt,
  And quaff my pure exhilarating tide.

III. Charade, *by Miſs Sally Browne, of Honiton.*

Ladies, you'll find, if Ovid tells us true,
My *firſt* was once a lady like to you.
But of my *ſecond*, ſiſters cautious be,
And every ſtep you take, beware of me.
My *whole*'s by Colin oft a preſent made
To his dear fav'rite, ſitting in the ſhade.

IV. Charade, *by Mr John Fildes, Schoolmaſter.*

See, to my *firſt* the gallant Edwin goes,
And leaves his Emma pierc'd with ſharpeſt woes;
They bid adieu with tears, and heaving ſighs
So weeps the parent when my *ſecond* dies.
To Edwin may my *whole* propitious prove,
And ſend him home in ſafety to his love.

V. Charade, *by Antonia.*

My *firſt* we all have cauſe to rue:
'Twas on my *ſecond* brought
By means of *third*: 'tis but too true,
As is in Scripture taught.

VI. Charade, *by Mr Philip Ruſher.*

Smack, the driver loves my *firſt*,
From my *ſecond* fills the bowl;
Wretched Delia's heart it burſt,
When her Damon nam'd the whole.

VII. Charade, *by Mr Wm Jones.*

My *firſt* is diſclos'd by her retrograde motion:
Like my flouriſhing *next* is the man of devotion;
That termagant, Doll, if ſhe meet with control,
Reſembles in look the north ſide of my whole.

VIII. Charade, *by Eugenio.*

Parent of beauty ſee my *firſt* appear,
Of gentle love, of muſic, and delight.
My foaming *ſecond* comes with mad career;
My *whole*'s my ſecond rais'd to greater height.

The numerous other curious and entertaining compoſitions of our ingenious correſpondents, muſt be reſerved to a future year, when ſuch of them as will either do credit to themſelves, or the Diary, will be inſerted in their turns. And the ſame is to be obſerved as to the new queſtions.—The new queſtion, concerning a muſical cord ſtretched into the three ſides of a triangle, is not limited, as the author might have found, if he had tried the ſolution. This is another inſtance of the propriety of requiring ſolutions to be ſent with new queſtions; a meaſure which muſt prevent many diſappointments to contributors, who might otherwiſe ſend crude and improper queſtions, and then be ſurpriſed, and blame the editor that they are not inſerted. But all gentlemen, who feel themſelves diſappointed as to the inſertion of their queſtions or ſolutions, and other compoſitions, would do well to recollect, that the editor can have no other view in the omiſſion of them, beſides their own credit, and that of the Diary.

For the exerciſe of young Tyros the following ſix eaſy practical Queſtions are here added, to receive Solutions next year, along with any Diary materials, directed for the "Ladies' Diary, Stationer's Hall."

NEW MATHEMATICAL QUESTIONS,

To be anſwered next Year.

I. Queſtion 1, *by the Rev Mr L Evans.*

Bought 30 pieces of cloth, at 3l. per piece, by the ſale of 20 pieces of which I gained 50 per cent: for how much muſt each of the remaining pieces be ſold to gain no more than 25 per cent in the whole?

II. Queſtion 2, *by Mr John Boden.*

If a penny be put out at 5 per cent compound intereſt, and 100l. at the ſame rate, ſimple intereſt; it is required to find in what time their amounts will be equal.

III. Queſtion 3, *by Mr James Wilding.*

I have a neighbour into whoſe poſſeſſion is fallen the leaſe of a farm, 24 years of which are unexpired, and which, not being able to occupy it, he has ſold for an annuity of 180l. for the time being.—Now he is deſirous of living at ſuch a rate as will enable him to realize at the end of the ſaid term, from his yearly ſavings and the intereſt of it (ſimple intereſt at 5 per cent) a ſum, which, when put out at the ſame rate of intereſt, will produce an income equal to what he allowed himſelf to live upon during the term of the annuity: it is required to determine his rate of living, and the capital that will be accumulated at the end of the ſaid term.

IV. Queſtion 4, *by Mr Wm Weatherill.*

The earth having been repeopled, after the deluge, by the three ſons of Noah and their wives; it is required to find in what proportion population muſt have increaſed, ſo that there might be 5 millions of inhabitants at the end of 300 years.

V. Queſtion 5, *by Mr John Campbell.*

To what height above the earth, in the latitude of London, muſt a common ſecond pendulum be taken, ſo that it ſhall make only 2 vibrations in a minute.

VI. Queſtion 6, *by Mr Matt Fleck.*

If a glaſs tube, 32 inches long, be filled with water to the height of 30 inches, and then inverted, as in the Torricellian experiment; it is required to find at what height the water will remain ſuſpended, the mercury in the barometer being at that time 29 inches high.

Of the ECLIPSES, TRANSIT *of* MERCURY, *and* COMET, *expected to appear this Year.*

In the courſe of the preſent year there will be ſeveral uncommon and extraordinary phenomena, or appearances, among the luminaries or heavenly bodies. For, beſides the eclipſes, which are common to other years, there will be a tranſit of Mercury over the face of the ſun, which is a more rare phenomenon, as well as a remarkable comet, which is expected to appear about the beginning of this year, which is rarer ſtill.

As to the ECLIPSES of the two great luminaries, there will be four this year, namely, two of the ſun, and two of the moon, but one of the latter only will be viſible in theſe parts. The order of their happening, and the circumſtances attending them, are as follows:

The firſt is an eclipſe of the moon, which will happen about 21$\frac{1}{2}$ hours of May the 8th, according to aſtronomical account, or on the morning of May the 9th, according to common or civil reckoning. The more exact times are as follows:

Beginning of the eclipſe	20 h	38 m	May 8, inviſible.
Middle of the ſame	21	31	
End of it - -	22	24	

Digits eclipſed are 2° 54′, or 2 digits and $\frac{9}{10}$, on the moon's northern limb; that is, almoſt $\frac{1}{4}$ of her diameter will be intercepted in the eclipſed part; the whole diameter being divided into 12 digits, marked °, and each digit into 60′, or minutes.

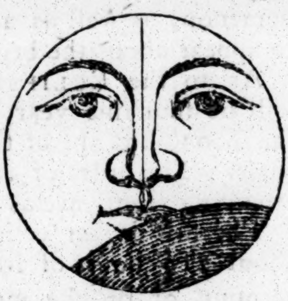
This eclipſe of the moon will be inviſible to theſe parts, becauſe ſhe is under our horizon at the time, being, at the middle of the eclipſe, vertical to a part of the great ſouth ſea, or Pacific Ocean, not far from the iſland of Otaheite; conſequently it will be inviſible to all Europe, Africa, and great part of the other two quarters of the globe; being only viſible to the ſouth-ſea iſles, with the eaſtern parts of Aſia, and the weſtern parts of America, as Otaheite, the Friendly Iſles, Sandwich Iſles, New Zealand, New Holland, where Botany Bay is ſituated; the Moluccas, Japan, Kamtſchatka, the interior and weſtern parts of North America, California, Mexico, Peru, Chili, Patagonia, Cape Horn, &c.

The ſecond will be an inviſible eclipſe of the ſun, on May the 24th, at almoſt half an hour paſt 10 at night, the conjunction of the luminaries being at 10 h 20$\frac{1}{2}$ m in $2^s\ 4^\circ\ 3'$ longitude, the moon's latitude being 30$\frac{1}{2}$ m ſouth. Alſo the ſun will be centrally eclipſed on the meridian at $10^h\ 18^m$ in longitude $154\frac{1}{2}$ degrees weſt, and $11\frac{1}{4}$ degrees of ſouth latitude. This, like all other eclipſes of the ſun, will be greater or leſs at different parts, according to their poſitions with reſpect to the courſe and track of the ſhadow of the moon over the earth, which is the cauſe of the obſcuration.

The 3d is a viſible eclipſe of the moon, near midnight of the 2d of November; the times and type of it as follows:

Beginning	11^h	$27\frac{3}{4}^m$
Middle	12	$32\frac{1}{4}$
End	13	$36\frac{3}{4}$

Type of the Middle of the Eclipſe.



Dig. eclipſed 3° 40′ on the moon's ſouthern limb, or a little more than $\frac{1}{4}$ of her diameter.

At the middle of this eclipſe the moon is vertical to Gaoga, in the centre of Africa; and therefore the eclipſe is viſible to all parts of the globe within the diſtance of a quadrant from that point; namely, all Africa, all Europe, almoſt all Aſia, Madagaſcar, Sumatra, the Atlantic, Ethiopic, and eaſtern oceans, with the greateſt part of South America, ſome of the north-eaſtern parts of North America, as New England, Nova Scotia, Canada, Labrador, and all the parts about the north-pole of the earth.

The fourth is an inviſible eclipſe of the ſun, on the 16th of November, according to aſtronomical account, or the 17th, by the civil reckoning; the conjunction of the ſun and moon being at $15^h\ 29^m$, or $3^h\ 29^m$ in the morning of the 17th day; the longitude of the two luminaries then being $7^s\ 25^\circ\ 16'$, and the moon's latitude 33′ north. The ſun will be centrally eclipſed on the meridian at 15 h 22 m, in $14\frac{3}{4}$ degrees of north latitude, and $129\frac{1}{2}$ degrees of eaſt longitude.

Of the TRANSIT *of* MERCURY.

Mercury and Venus are the only two planets which can appear to us to make a tranſit, or paſſage over the diſc or face of the ſun, which they do now-and-then at ſome of their inferior conjunctions. Now the orbit of Mercury is inclined 7 degrees to the ecliptic, or makes an angle of 7 degrees with it, croſſing it in two oppoſite points, called the planet's nodes; that node at which he aſcends northward above the ecliptic, being in the 15th degree of Taurus, and conſequently the oppoſite, or deſcending node, in the 15th degree of Scorpio. Now the ſun comes to theſe points in the ecliptic on the 5th of May, and the 6th of November; and conſequently, when Mercury comes to either of theſe nodes, about the times of his inferior conjunction with the ſun, that is, when the planet is between the earth and ſun, or in the nearer part of his orbit, he will appear to paſs over the diſc or face of the ſun, like a dark round ſpot; but if the conjunction of the ſun and planet, at ſuch times, ſhould be what is called the ſuperior ones, or when the planet is on the other ſide of the ſun, then it is evident that, paſſing behind the ſun's body, the planet will be occulted or hid by him: at all other times of their conjunctions the planet will paſs a little above, or a little below the ſun, on account of the planet's latitude either north or ſouth, which carries the planet above or below the ſun, if the latitude exceeds the ſun's ſemi-diameter, or about 16′.

As it is only the dark ſide of the planet that we ſee, like a ſmall round ſpeck on the luminous ground of the ſun's diſc, it cannot be ſeen with the naked eye, being too ſmall for that purpoſe, its diameter ſubtending an angle of only 12″, which is but about the 150th part of the ſun's diameter; and therefore it will require a teleſcope of ſome kind, magnifying at leaſt 4 or 5 times, to render the planet viſible; the ſmalleſt angle under which objects can be ſeen, that are not luminous, being about 1 minute.

The tranſits of Mercury and Venus are of great importance in aſtronomy, and eſpecially the latter; they ſerve to determine exactly the place of the planet's nodes, and the heliocentric longitude, independent of the annual parallax. But the tranſits of Venus are particularly uſeful in determining exactly the parallax of the ſun, upon which depends the diſtances of all the planets among themſelves, and with reſpect to us. Kepler was the firſt who predicted the time of the tranſits of Venus or Mercury; and in 1629 actually predicted a tranſit of Mercury for 1631, and two of Venus, the one for 1631, and the other for 1761.—In 1691, Dr Halley calculated the times of the tranſits of Mercury and Venus for a long ſeries of years. But the firſt account of an obſerved tranſit of Mercury was given by Gaſſendus, which he obſerved at Paris, on the morning of the 7th of November, 1631, and which he prepared himſelf to obſerve, in conſequence of Kepler's prediction two years before, as above-mentioned. The ſame tranſit was obſerved by three or four other obſervers, in different parts of Germany: but it was the obſervations of Gaſſendus that were chiefly uſeful to aſtronomers, in rectifying their tables.

Since that time we have had many other obſervations of the tranſits of Mercury. The next tranſit obſerved was by Mr Shakerley, on Nov. 3, 1651, who went from England to Surat, in the Eaſt-Indies, on purpoſe to obſerve it; and the obſervation is related in Wing's *Aſtronomia Britannica*.—The 3d obſerved tranſit, in 1661, May 3, was obſerved at Dantzick by Hevelius; and at London by Huygens, Mercator, and Street.—4th, The tranſit of Nov. 7, 1677, was obſerved by Dr Halley at St Helena, where he had gone to make that obſervation, and to obſerve the ſtars about the ſouth pole. This tranſit was alſo obſerved by Mr Townley, in England; by Mr Gallet at Avignon, and by another perſon at Montpelier—5th, The tranſit of Nov. 10, 1690, was obſerved at Canton in China, by the Jeſuits Fontanay and Le Comte; at Sommerfield, near Leipſic, by Michael Arnoldus; at Nuremberg, by Mr Wurtzelbaur; and at Warſaw, by father Kochanſki.—6th, The tranſit of Nov. 3, 1697, was obſerved at Paris, by Meſſieurs Caſſini, Maraldy, and De la Hire; at Rotterdam, by Mr Caſſini, jun. in China, by the Jeſuits Fontanay and Wiſdeloup; and at Neuremberg, by Mr Wurtzelbaur.—7th, The tranſit of May 5, 1707, was ſeen at Copenhagen, by M. Roemer.—8th, The tranſit of Nov. 9, 1723, was obſerved at London, at Paris, at Genes, at Bologna, at Padua, &c. and the obſervations made profitable uſe of by Halley and de Liſle.—9th, The tranſit of Nov. 11, 1736, was obſerved to very good effect, in many parts of Europe; both the immerſion and emerſion having been well taken.—10th, The tranſit of May 2, 1740, was obſerved only at Cambridge, in New England, by Mr Wintrop. Mr de Liſle went on purpoſe to Bereſow, in Siberia, to obſerve it; but had the painful diſappointment to find the ſun quite covered with thick clouds at the time, and only to diſſipate, and the weather clear up, about an hour after the tranſit was over.—11th, The tranſit of Nov. 5, 1743, was obſerved all over Europe; as was alſo, 12th, that of May 6, 1753.—As alſo were thoſe of Nov. 7, 1756; of Nov. 9, 1769; of Nov. 12, 1782; and of May 3, 1786.

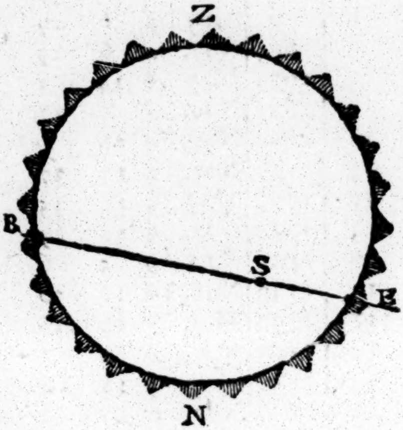
The following is a complete liſt of all the tranſits of Mercury that happen from the year 1600 to the year 1900; viz. the mean time of the true conjunction for the meridian of Greenwich, with the true geocentric longitude and latitude at that time.

All the TRANSITS *of* MERCURY *over the* SUN *for* 300 *Years.*

Number.	Year.	Mean Time of true Conjunction at Greenwich.					Geocen. Longit. at the Conjunction.				Geocen. Latit. at the Conj.		
1	1605	Nov.	1^d	7^h	48^m	13^s	7^s	9°	29$'$	20$''$	13$'$	58$''$	s
2	1615	May	3	1	14	34	1	12	34	17	6	33	n
3	1618	Nov.	4	1	40	14	7	12	5	32	5	32	s
4	1628	May	5	9	11	1	1	15	38	59	10	52	s
5	1631	Nov.	6	19	27	54	7	14	41	45	2	48	n
6	1644	Nov.	8	13	12	9	7	17	17	56	11	7	n
7	1651	Nov.	2	12	38	14	7	10	32	10	12	16	s
8	1661	May	3	6	49	42	1	13	38	17	3	36	n
9	1664	Nov.	4	6	29	34	7	13	8	21	3	58	s
10	1674	May	6	14	51	21	1	16	43	19	13	51	s
11	1677	Nov.	7	0	17	4	7	15	44	33	4	25	n
12	1690	Nov.	9	18	0	0	7	18	20	44	12	44	n
13	1697	Nov.	2	17	37	50	7	11	35	2	10	40	s
14	1707	May	5	12	35	44	1	14	43	5	0	37	n
15	1710	Nov.	6	11	19	14	7	14	11	12	2	19	s
16	1723	Nov.	9	5	6	36	7	16	47	26	6	0	n
17	1736	Nov.	10	22	50	24	7	19	23	38	14	21	n
18	1740	May	2	10	38	20	1	12	43	23	14	52	n
19	1743	Nov.	4	22	17	44	7	12	37	50	9	3	s
20	1753	May	5	18	16	21	1	15	47	28	2	22	s
21	1756	Nov.	6	16	8	44	7	15	14	3	0	42	s
22	1769	Nov.	9	9	56	44	7	17	50	19	7	39	n
23	1776	Nov.	2	9	12	24	7	11	4	26	15	45	s
24	1782	Nov.	12	3	39	25	7	20	26	30	15	50	n
25	1786	May	3	16	17	44	1	13	47	44	12	3	n
26	1789	Nov.	5	3	7	19	7	13	40	37	7	25	s
27	1799	May	6	23	56	32	1	16	51	52	5	20	s
28	1802	Nov.	8	20	58	19	7	16	16	53	0	55	n
29	1815	Nov.	11	14	44	14	7	18	53	7	9	15	n
30	1822	Nov.	4	14	2	30	7	12	7	14	14	8	s
31	1832	May	4	21	56	56	1	14	52	6	9	3	n
32	1835	Nov.	7	7	57	34	7	14	43	31	5	49	s
33	1845	May	8	5	37	20	1	17	56	17	8	19	s
34	1848	Nov.	9	1	47	44	7	17	19	44	2	31	n
35	1861	Nov.	11	19	34	34	7	19	56	0	10	52	n
36	1868	Nov.	4	18	53	18	7	13	10	7	12	33	s
37	1878	May	6	3	35	56	1	15	56	25	6	8	n
38	1881	Nov.	7	12	46	54	7	15	46	20	4	12	s
39	1891	May	9	11	17	56	1	19	0	41	11	19	s
40	1894	Nov.	20	6	37	24	7	18	22	40	4	9	n

It would require a great deal more room than the narrow limits of theſe pages will afford, to lay down the calculation, projection, obſervation, and uſes of the tranſits of Mercury and Venus, which are to be found in the different authors. We muſt therefore content ourſelves at preſent, with a brief abſtract of the circumſtances of the enſuing tranſit of Mercury, which will happen this year, on the 5th of November, and ſome of the moſt material uſes that have been drawn from ſuch tranſits.

Type of the Tranſit of Mercury over the Sun, Nov. 5, in the afternoon.



Annexed is a type of the tranſit of Mercury, as it will happen this year, on Nov. 5, in the afternoon, as ſeen from the Royal Obſervatory at Greenwich, near London. B is the beginning, or central ingreſs of Mercury on the ſun's diſc; E is the end, or central egreſs of the planet; S is the place of the planet at the time of ſun-ſet; B S E its track over the ſun, from eaſt to weſt, beginning on the left hand, rather below the middle of the ſun's diſc, and paſſing towards the lower part on the right hand; Z the zenith or higheſt point of the ſolar diſc, and N the nadir or loweſt point of it. The

Beginning at B is at $1^h\ 10^m$, latit. of ☿ then $9'\frac{1}{3}$ ſouth,
End at E is at - 6 4 , latit. of ☿ then $5\frac{1}{4}$ ſouth,
Sun-ſet when at S at 4 40 , latit. of ☿ then $6\frac{1}{2}$ ſouth,
apparent time.

The planet is too ſmall to be ſeen with the naked eye, and therefore ſome ſort of a teleſcope muſt be uſed, to aſſiſt the eye.

By the obſervations of ſuch tranſits, the elements of the planet are rectified, and the tables for calculating their places corrected; alſo the parallax of the ſun, and thence the real diſtances of all the planets are more correctly aſcertained. From the obſervations of the tranſits of Venus, made by many perſons, in the years 1761 and 1769, the mean annual parallax has been ſettled at about $8''\frac{3}{5}$; conſequently the mean diſtance of the earth from the ſun is about $95\frac{1}{9}$ millions of miles, and the circumference of the annual orbit of the earth $597\frac{1}{2}$ millions of miles. And as the earth deſcribes this orbit in 365 days 6 hours, or in 8766 hours, it follows that it travels at the rate of 68200 miles every hour, or 1137 miles in a minute, or nearly 20 miles in a ſecond of time; ſo that its velocity in its orbit is about 60 times ſwifter than that of a cannon-ball juſt when it comes out of the mouth of the cannon, which at moſt is near 2000 feet in a ſecond, or about 20 miles in a minute; and therefore, at this rate, it would take about 9 years and 13 days to move from the earth to the ſun.

Of the COMET.

A Comet is alſo expected to appear about the beginning of this year. From the ſimilarity of the elements of the comets which appeared in 1532 and 1661, Dr Halley judged, that they were the ſame comet; and that therefore it will again appear in the beginning of the year 1789. The interval between the paſſages of the comet by its perihelion, or neareſt point to the ſun, between 1532 and 1661, was about 128 years 89 days; and if it ſhall return in the ſame period again, it has been found by Dr *Maſkelyne*, the Aſtronomer Royal, that it will come to its perihelion about the 27th day of April, this year. The comet of 1532 was obſerved by *Apian*, and that of 1661 by *Hevelius*, and others. The imperfect obſervations of the former of theſe, and the diſturbing forces acting upon it in its paſſage by the planets Jupiter and Saturn, contribute to cauſe much uncertainty on the exact period and return of this comet. And of ſo much conſequence have theſe latter circumſtances been held, that the Royal Academy of Sciences at Paris, offered a reward of 6000 livres, or 250 l. ſterling, for a good computation of the effect of thoſe diſturbing forces on the motion and appearances of the comet; but hitherto without effect, as no ſatisfactory anſwers have yet been received.—If this comet ſhould come to its perihelion on Jan. 1, 1789, it may probably be viſible, with a good acromatic teleſcope, in its deſcent towards the ſun, about the middle of Sept. 1788; and ſooner or later, according as the perihelion ſhall be ſooner or later, that is, about 3 months and a half before its time in the perihelion. It will approach us from the ſouthern parts of its orbit, and therefore it will firſt appear with conſiderable ſouth latitude, and ſouth declination; ſo that perſons reſiding nearer the equator than we do, or in ſouth latitude, will have an opportunity of diſcovering it before us; and therefore ſuch a part as the Cape of Good Hope would be a good place for making the firſt obſervations upon it.—The elements of this comet are as follows, ſo far as they are hitherto known, and given by the Aſtronomer Royal; viz.

Time of the perihelion Jan. 1, 1789, at noon.
Perihelion diſtance 0·44851.
Place of the aſcending node $2^s\ 24^\circ\ 18'$.

Inclination of orbit to the ecliptic 32° 36′.
Perihelion forwarder in orbit than its ☊ 33° 28′.
Its period is about $128\frac{1}{4}$ years.
And its motion is direct, or in the order of the ſigns.

ANSWERS *to the* MATHEMATICAL QUESTIONS, *propoſed in the laſt Year's Diary.*

I. Queſtion 878 *anſwered by Mr James Spilling.*

The two given equations are,

1ſt, - $2x^3-x^4-x^2+2x^2y-y^2=2xy$,

2d - - $\sqrt{x^5y}-\sqrt{x^3y}=2xy$.

Divide the 2d by $\sqrt{xy}$, then $x^2-x=2\sqrt{xy}$; the ſquare of this is $x^4-2x^3+x^2=4xy$; this added to the 1ſt, and divid. by y, gives $2x^2-6x=y$; this multiplied by 4, and the line above divided by x, give $4y$, viz. $x^3-2x^2+x=8x^2-24x$; hence $x^2-2x+1=8x-24$, or $x^2-10x+25=0$; therefore $x=5$, and $y=20$. Conſequently the two ages are 20 and 25 years.

The ſame by Wm Simpſon, junr.

The firſt tranſp. is $x^4+x^2+2xy+y^2-2x^3-2x^2y=0$,

or $x^4-2x^2.\overline{x+y}+\overline{x+y}^2=0$,

the root of which is $x^2-\overline{x+y}=0$, and hence $x^2-x=y$. The 2d equ. by diviſion, gives $x^2-x=2\sqrt{xy}=y$; therefore $y=4x=x^2-x$; therefore $x^2=5x$, and $x=5$. And the ages 20 and 25.

The ſame by Mr John Cavill.

Write v^2 for x, and z^2 for y, to avoid radicals. Then the laſt equa. becomes $v^5z-v^3z=2v^2z^2$; which divided by v^2z, gives $v^3-v=2z=2\sqrt{y}$; the ſquare of this is $v^6-2v^4+v^2=4z^2$, or $x^3-2x^2+x=4y$. Then the 1ſt equ. tranſpoſed, and the root extracted, gives $x^2-x=y$. Hence $4y$, or $4x^2-4x=x^3-2x^2+x$. Divide by x, then $x^2-2x+1=4x-4$, or $x^2-6x=-5$, and hence $x=5$. Then $y=20$; and the ages are 20 and 25.

Ingenious anſwers to this queſtion were alſo given by Meſſieurs *James Adams, Allenſis, Amicus, James Aſhton, John Boden, Rob Bretherick, Geo Brown, John Burrow, John Campbell, R Carliſle, Chriſtianus, S Clement, T Cock, Joſ Cowing, T Croſbey, John Culyer, John Dalton, Rd Dening, L Evans, John Farey, Matt Fleck, J Hartley, John Howard, D Kinnebrook, O T Linley, Thos Metcalfe, Wm Mudge, Joſ Nendick, Philalethes Cleaſbyenſis, Geo Roberts, Alex Rowe, I Saul, John Shakeſpear, Joe Sherwin, Matt Terry, Henry Tilney, J Walton, W Weatherill, Wm White, James Williams, and Joſ Youle.*

II. Queſtion 879 *anſwered by Mr Tho Metcalfe, of Marſitt.*

Let $x =$ the length, and $y =$ the breath; then $xy =$ the area.
Then $\overline{x+5} \times \overline{y+2}$, or $xy + 2x + 5y + 10 = xy + 430$,
and $\overline{x+2} \times \overline{y+5}$, or $xy + 5x + 2y + 10 = xy + 445$.
Or by equal ſubtr. $2x + 5y = 420$,
and $5x + 2y = 435$.
The ſum of theſe two is $7x + 7y = 855$, or $x + y = 122\frac{1}{7}$;
and their dif. is - $3x - 3y = 15$, or $x - y = 5$.
Then the half ſum and dif. of theſe give $x = 63\frac{4}{7}$, and $y = 58\frac{4}{7}$.

The ſame by Mr John Burrow, of Boltonfield.

Having ſubſtituted and proceeded as above, till there be found

$$2x + 5y = 420, \text{ and}$$
$$5x + 2y = 435.$$

Multiply the former of theſe by 2, and the later by 5, and take their dif. ſo ſhall $21x = 1335$, or $7x = 445$; and hence $x = 63\frac{4}{7}$.

Again mult. the latter by 2 and the former by 5, and take their dif. ſo ſhall $21y = 1230$, or $7y = 410$; and hence $y = 58\frac{4}{7}$.

Other ingenious ſolutions were alſo given by Meſſieurs *James Adams, Amicus, Allenſis, James Aſhton, John Boden, Rd Ball, Rob Barwick, Geo Beſwick, Rob Bretherick, Geo Brown, John Cairns, John Campbell, R Carliſle, John Cavill, Chriſtianus, S Clement, T Cock, Joſ Cowing, John Craggs, I Croſbey, John Cullyer, John Dalton. Rd Dening, Dunelmenſis, L Evans, John Farey, H Gregory, I Hartley, Jonathan Hornby, John Howard, Wm King, D Kinnebrook junr, John Liddell, Wm Mudge, Joſ Peace, Philalethes Cleaſbyenſis, Wm Quaiſe, Geo Roberts, Alex Rowe, E E Semai, John Shakeſpear, Joe Sherwin, C Sleight, James Spilling, I Saul, Geo Stevenſon, Matt*

Terry, J Walton, W Weatherill, Wm White, Abel Whitehouſe, James Williams, and Joſ Youle.

III. Queſtion 880 *anſwered by Mr James Williams.*

[*See the fig. to the ſolut. of the ſame queſt. in the Diary.*]

Let EH repreſent the ſun's altitude when due eaſt, DE his declination, and DH the hour from 6; then $\angle$H is the latitude. By Simpſon's Spherical Trig. prop. 22, as cot. $\frac{1}{2}\angle$H : tan. $\frac{1}{2}\angle$H :: ſin. EH + HD : ſin. EH − DH; therefore, that ſin. EH − DH may be a maximum, the ſin. EH + DH muſt be a maximum; conſeq. EH + DH muſt be $= 90°$; and then our proportion becomes cot. $\frac{1}{2}\angle$H : tan. $\frac{1}{2}\angle$H :: rad. : ſin. EH — DH, that is, rad. : tan. $\frac{1}{2}$H :: tan. $\frac{1}{2}$H : ſin. EH — DH $= 8{\cdot}5773046 =$ ſin. 2° 9′ 53″. Hence the altitude $= 46° \, 4' \, 57''\frac{1}{2}$, aſc. dif. $= 43° \, 55' \, 2''\frac{1}{2}$, and decl. $= 15° \, 39' \, 18''$, anſwering to May 2d, 8^{h} 55′ 40″ in the morning.

The ſame by Mr James Adams, of Stonehouſe.

Put the tang. (radius 1) of the aſcenſional dif. $= x$, and the coſine of the given lat. $= m$. By ſpherics we have $x : m :: 1 : \frac{m}{x}$ the cot. of the ſun's alt. at 6 o'clock, conſeq. $\frac{x}{m}$ will repreſent its tangent, and the tang. of the dif. between the ſun's aſcenſ. dif. and alt. at 6, will be repreſented by $\frac{m - 1}{m + x^2} \times x$, which by the queſt. is a max, whoſe flux. made $= 0$, and reduced, we have $x = \sqrt{m}$; but $x \times \frac{x}{m} = 1$, therefore the alt. and aſc. dif. are complements to each other. Hence half the ſum of the log. coſ. of lat. and radius, is the log. tang. of the aſc. dif. $= 43° \, 55'$, and its comp. 46° 5′ is the alt. Therefore the decl. is readily found 15° 40′ nearly, anſwering to May 2d.

Other ingenious anſwers were alſo given by Meſſieurs *Allenſis, John Birch, John Burrow, John Campbell, Chriſtianus, S Clement, T Cock, Joſ Cowing, John Cullyer, John Dalton, L Evans, John Farey, J Hornby, John Howard, Wm Mudge, Alex Rowe, and Wm White.*

IV. Queſtion 881 *anſwered by Mr Joſ Cowing, of Newcaſtle.*

The different ways it is poſſible to throw 9 halfpence is $2^9 = 512$, and the different ways to throw 3 heads are $1 + 3 + 6 + 10 + 15 + 21 + 28 = 84$; therefore $\frac{84}{512} = \frac{21}{128}$ is the probability of throwing 3 heads at one throw, and $\frac{21^4}{128^4} \cdot \frac{107}{128}$ is the probability of throwing 3 heads the 4 firſt throws, and miſſing the fifth. But it is equally probable that he may miſs the 1ſt, 2d, 3d, and 4th throws, and hit all the reſt: therefore $\frac{21^4}{128^4} \cdot \frac{107}{128} \cdot 5 = \frac{104047335}{34359738368}$ is the probability of throwing 3 heads 4 times, and miſſing once in the 5 throws. Whence the odds he ought to take are as 329 guineas to 1 nearly.

Other anſwers were given by Meſſieurs *James Adams, Allenſis, Amicus, John Boden, R Carliſle, John Campbell, John Craggs, John Cullyer, John Dalton, John Farey, John Howard, Wm Mudge, I Saul, Tim Simpſon, Geo Stevenſon, and James Williams.*

V. Queſtion 882 *anſwered by Mr Abel Whitehouſe.*

By the laws of pendulums it appears, that the lengths, to vibrate in the ſame time, are directly as the power of gravity. And the force of gravity has been found to be reciprocally as the ſquare of the diſtance from the earth's centre, which in the preſent caſe is as 4^2 to 1, or 16 to 1. And becauſe the length of the ſeconds pendulum, in the latitude of London, is juſt $39\frac{1}{8}$ inches; therefore $16 : 1 :: 39\frac{1}{8} : 2.444$ inches, the length required.

Other ingenious anſwers were alſo given by Meſſieurs *Adams, Allenſis, Amicus, Aſhton, Ball, Birch, Boden, Bretherick, Brown, Burrow, Campbell, Carliſle, Cavill, Chriſtianus, Clement, Cowing, Craggs, Cullyer, Evans, Howard, Mudge, Peace, Philalethes Cleaſbyenſis, Rowe, Spilling, Stevenſon, Terry, White, Williams, and Youle.*

VI. Queſtion 883 *anſwered by the Rev Mr L Evans.*

Let DE be the circular ſection parallel to the baſe (*ſee the fig. to the ſame queſt. in the Diary*), and GDH the ſection parallel to the ſide AB, which it is well known is a parabola; whoſe axis DF or DC put $= x$; alſo put $b =$ BC $= 8$ the diameter of the baſe, and $s =$ AC or BC $= \sqrt{116}$ the ſlant ſide; alſo $p = \cdot 7854$. Now, by ſimilar triangles, $s : x :: b : \frac{bx}{s} =$ FC; therefore $b - \frac{bx}{s}$ or $b \times \frac{s - x}{s} =$ BF or DE. And, by the nature of the circle, GH $= 2\sqrt{\text{BF} \cdot \text{FC}} = \frac{2b}{s}\sqrt{x \cdot \overline{s-x}}$. But $p \cdot \text{DE}^2$ or the area of the circle, muſt be equal to $\frac{2}{3}\text{DF} \cdot \text{GH}$ or the area of the parabola; that is, $pb^2\left(\frac{s-x}{s}\right)^2 = \frac{4bx}{3s}\sqrt{x \cdot \overline{s-x}}$, or $\frac{pb}{s} \cdot \overline{s-x}^2 = \frac{4}{3}x\sqrt{x \cdot \overline{s-x}}$; hence $\frac{pb}{s} \cdot \overline{s-x}^{\frac{3}{2}} = \frac{4}{3}x^{\frac{3}{2}}$, and $\frac{s-x}{x}$ or $\frac{\text{AD}}{\text{DC}} = \left(\frac{4s}{3pb}\right)^{\frac{2}{3}} = 1 \cdot 7351$; that is, AD is to DC, or BF to FC, in the ratio of 1.7351 to 1; which being therefore divided in that ratio, gives the point D as required.

Other ingenious ſolutions were alſo given by Meſſieurs *Adams*, *Allenſis*, *Amicus*, *Aſhton*, *Ball*, *Birch*, *Bretherick*, *Campbell*, *Carliſle*, *Cavill*, *Clement*, *Cock*, *Cowing*, *Craggs*, *Croſbey*, *Dalton*, *Farey*, *Howard*, *King*, *Kinnebrook*, *Mudge*, *Philalethes Cleaſbyenſis*, *Roberts*, *Rowe*, *Saul*, *Simpſon*, *Stevenſon*, *Truſwell*, *Walton*, *Weatherill*, *White*, *and Williams*.

VII. Queſtion 884 *anſwered by Mr Da. Kinnebrook, junr.*

Let OB the radius of the circle $= 1$, BF $= x$ [*See the fig. in the Diary*]. Then, by ſim. triangles, BF : BA :: BO : BE, that is, $x : 2 :: 1 : \frac{2}{x} =$ BE; hence EF $= x - \frac{2}{x}$, and DE $= \frac{2}{x} - 1$; conſeq. DE . EF or $\overline{x - \frac{2}{x}} \times \overline{\frac{2}{x} - 1}$ is a max. by the queſt. which put into fluxions, and reduced, gives $x^3 + 2x = 8$, the root of which is $x = 1 \cdot 6702431 =$ BF; whence DE $= \cdot 1974304$, and EF $= \cdot 4728126$; and therefore DE . EF $= \cdot 0933476$, the greateſt rectangle.

The ſame by Mr Joſeph Youle, Schoolmaſter, near Sheffield.

Let the figure be drawn as per queſtion, and let OG be perp. to BF, and put BG or FG $= x$, radius 1. Then, by ſim. triangles, BG : BO :: BO : BE $= \frac{1}{x}$; therefore EG $= \frac{1}{x} - x$, ED $= \frac{1}{x} - 1$, and EF $= 2x - \frac{1}{x}$; therefore ED . EF or $\overline{\frac{1}{x} - 1} \times \overline{2x - \frac{1}{x}}$ is a maximum; the fluxion of which put $= 0$, and reduced, gives $x^3 + \frac{1}{2}x = 1$, the root of which equation is $\cdot 8351223$; conſequently EF $= \cdot 4728152$, and DE $= \cdot 1974294$.

Various other ingenious ſolutions were given by Meſſieurs *Adams*, *Allenſis*, *Amicus*, *Ball*, *Burrow*, *Bretherick*, *Brown*, *Campbell*, *Carliſle*, *Cavill*, *Clement*, *Cock*, *Cowing*, *Craggs*, *Croſbey*, *Dalton*, *Evans*, *Farey*, *Howard*, *Mudge*, *Peace*, *Philalethes Cleaſbyenſis*, *Rowe*, *Saul*, *Simpſon*, *Truſwell*, *White*, *and Williams*.

VIII. Queſtion 885 *anſwered by Amicus, the propoſer.*

Let ACFH repreſent ſuch a ſection of the block as would divide it into two equal parts, BG the axis, D the centre of gravity, and P the needle [*See the fig. to the firſt ſolut. in the Diary*]. Then, per queſtion, the ſide of which AH is the middle line, muſt be parallel to the horizon, and therefore perp. to DP. Draw AI parallel to BG, LD to AH, and AL to DP. Then the ſide of the leſſer baſe $= 6 =$ AB$\sqrt{\frac{4}{3}}$, $6\sqrt{\frac{3}{4}} =$ AB $= c$, and $3c^2\sqrt{\frac{4}{3}} = 2c^2\sqrt{3} =$ the area of the leſs end. Let BG $=$ AI $= l$, AP $=$ LD $= 12 = a$, GH $-$ AB $=$ IH $= 3\sqrt{\frac{3}{4}} = d = \frac{1}{2}c$; then by mechanics BD $= \frac{\frac{1}{4}d^2 + \frac{2}{3}cd + \frac{1}{2}c^2}{\frac{1}{3}d^2 + cd + c^2} \times l = \frac{\frac{1}{4} + \frac{4}{3} + 2}{\frac{1}{3} + 2 + 4}l = \frac{43}{76}l = ml$: alſo $l : d :: c : \frac{dc}{l} =$ BE, and $l : \sqrt{l^2 + d^2} :: a :$ ED, hence ED $+$ BE $=$ BD, or $ml^2 - dc = a\sqrt{l^2 + d^2}$; then $\overline{l^2 - \frac{dc}{m}}^2 = \frac{a^2l^2}{m^2} + \frac{a^2d^2}{m^2}$, and $l = \sqrt{\frac{dc}{m} + \frac{a^2}{2m^2} + \frac{a}{m}\sqrt{d^2 + \frac{dc}{m} + \frac{a^2}{4m^2}}} = 22\cdot 41578$ the length required.

The ſame anſwered by Matt Terry, Land Surveyor, of Aſkrigg.

Put $a = 9$ the ſide of the greater end, $b = 6$ the ſide of the leſſer end, and $x =$ the length of the fruſtum. Then, per page 74 Hutton's Mathematical Miſcellany, the diſtance of the centre of gravity from the leſs end will be expreſſed by $\frac{3a^2 + 2ab + b^2}{a^2 + ab + b^2} \times \frac{1}{4}x$, which being made $= 12 = c$, if it be meant that 12 is the perp. diſtance from that end, gives $x = \frac{a^2 + ab + b^2}{3a^2 + 2ab + b^2} \times 4c = 21{\cdot}1$ inches, the length of the block.

But if it is meant that the length AP along the middle of one face is 12, then the correſponding length AK parallel to the axis BG, will exceed AP or 12, in the proportion of AI to AH, the length of the axis to the ſlant ſide. To find which, firſt AB or GI $= \sqrt{6^2 - 3^2} = \sqrt{27} = 3\sqrt{3}$, and GH $= \sqrt{9^2 - 4{\cdot}5^2} = \sqrt{60\frac{3}{4}} = \frac{9}{2}\sqrt{3}$, therefore IH or GH$-$GI $= \frac{9}{2}\sqrt{3} - 3\sqrt{3} = \frac{3}{2}\sqrt{3}$, and the ſlant ſide AH $= \sqrt{\text{AI}^2 + \text{IH}^2} = \sqrt{x^2 + 6\frac{3}{4}}$; then AI : AH : : AP : AK $= \frac{c}{x}\sqrt{x^2 + 6\frac{3}{4}}$. Now ſubſtitute this inſtead of c in the former part, then is $\frac{3a^2 + 2ab + b^2}{a^2 + ab + b^2} \times \frac{1}{4}x = \frac{c}{x}\sqrt{x^2 + 6\frac{3}{4}}$, or $\frac{43}{19} \times \frac{1}{4}x = \frac{12}{x}\sqrt{x^2 + 6\frac{3}{4}}$, or $\frac{43}{912} - x^2 = \sqrt{x^2 + 6\frac{3}{4}}$; which quadratic equation being reſolved, we have $x = 22{\cdot}4157$ for the length of the block in this caſe.

Other ingenious ſolutions were given by Meſſieurs *Adams*, *Allenſis*, *Aſhton*, *Ball*, *Birch*, *Burrow*, *Cavill*, *Clement*, *Cowing*, *Craggs*, *Croſbey*, *Cullyer*, *Howard*, *Mudge*, *Rowe*, *White*, *Williams*, *and Youle*.

IX. Queſtion 886 *anſwered by Mr John Dalton.*

The rule in this queſtion is only Kerſey's in a form applicable to Compound Intereſt. For let $n' - n = m$, $n'' - n = p$, $n''' - n = q$; alſo $r =$ amount of one pound for one year, and $t =$ the equated time from n; then, by Kerſey's rule, we get this equation, $a + \frac{b}{r^m} + \frac{c}{r^p} + \frac{d}{r^q} \times r^t = a + b + c + d$;

whence $r^t = \dfrac{a+b+c+d}{a+\dfrac{b}{r^m}+\dfrac{c}{r^p}+\dfrac{d}{r^q}}$, wherefore their logarithms will be equal alſo; but log. of $r^t = t\,.\,\text{log. } r$, and log. $\dfrac{a+b+c+d}{a+\dfrac{b}{r^m}+\dfrac{c}{r^p}+\dfrac{d}{r^q}} = \text{log.}\, a+b+c+d - \text{log.}\, a+\dfrac{b}{r^m}+\dfrac{c}{r^p}+\dfrac{d}{r^q}$,

consequently $t = \dfrac{\text{log.}\, a+b+c+d - \text{log.}\, a+\dfrac{b}{r^m}+\dfrac{c}{r^p}+\dfrac{d}{r^q}}{\text{log. } r}$, which is the rule in the queſtion.

The truth of Malcolm's rule, which determines the equated time, from the ſuppoſition, that the intereſt on the debts foreborn, ſhould be equal to the diſcount of the debts not due, is too evident to be here inſiſted on; and that Kerſey's rule will, in this caſe, agree with this ſuppoſition, may be thus proved: Let the term of t, as found by this rule, fall between the terms of m and p, then will $a+\dfrac{b}{r^m}+\dfrac{c}{r^p}+\dfrac{d}{r^q}+$ their intereſt for the time $t = a+b+c+d$; but the amount of $\dfrac{b}{r^m}$ for the time $t = b +$ its intereſt for the time $t-m$, and the amounts of $\dfrac{c}{r^p}$ and $\dfrac{d}{r^q}$ at the term of $t =$ the then preſent worths of c and $d = c+d-$their diſcount from the term of t; wherefore, as $a+b+$ their intereſt at the term of $t+c+d-$their diſcounts from that term $= a+b+c+d$, it follows that the intereſts of the two former are equal to the diſcounts of the two latter, which agrees with Malcolm's ſuppoſition. The common method will alſo give the ſame reſult on Moreland's principle, but not on Hatton's or Cocker's: for, putting v for the diſtance of the equated term, from that when the debt laſt payable becomes due, we have, on his ſuppoſition, $\overline{a+b+c+d}\,.\,r^v = ar^q + br^{q-m} + cr^{q-p} + d$, and, dividing both ſides by r^v, $a+b+c+d = \dfrac{ar^q+br^{q-m}+cr^{q-p}+d}{r^v} = a+\dfrac{b}{r^m}+\dfrac{c}{r^p}+\dfrac{d}{r^q}\,.\,r^{q-v}$ (t), an expreſſion the ſame as that deduced from Kerſey's rule above.

Ingenious anſwers were alſo given by Meſſieurs *Chriſtianus*, *Howard*, *Mudge*, and *Rowe*.

X. Queſtion 887 *anſwered by Lieutenant Wm Mudge, of the Royal Artillery.*

Sir Iſaac Newton's equation to the 44th ſpecies, or the defective hyperbola, is $CP \cdot PE^2 = BP \cdot AP^2$, that is, $CP : PB :: AP^2 : PE^2$ [*See the fig. to the firſt ſolut. of the ſame queſt. in the Diary*]. But, by ſim. tri. $AP^2 : PE^2 :: AD^2 : DB^2 :: AL : LB$ by the nature of the circle; therefore, by equality $AL : LB :: CP : PB$; and by compoſ. $AB : LB :: CB : PB$, or $AB : CB :: LB : PB ::$ (by ſim. tri.) $DF : EF$; laſtly, by diviſion, $AC : CB :: DE : EF$. *Q. E. D.*

XI. Queſtion 888 *anſwered by Mr S Clement, Schoolmaſter.*

The ſtick being a ſmall cylinder, the centre of oſcillation is at $\frac{2}{3}$ of its length from the vertex, therefore the length of the pendulum is $\frac{2}{3}$ of 5 or $3\frac{1}{3}$ feet; and from the data the perp. altitude of the whole cone is $\sqrt{5^2 - 3^2}$ or 4 feet; theref. $5 : 4 :: 3\frac{1}{3} : 2\frac{2}{3}$ feet, the altitude of the cone above the centre of oſcillation, which put $= a$; alſo put $q = 3\cdot1416$, and $s = 16\frac{1}{12}$: then will $q\sqrt{\frac{2a}{s}} = 1\cdot809$ ſeconds, the time of one revolution; conſeq. $7 \times 1\cdot809 = 12\cdot663$ is the time between the lightning and thunder; then as $1'' : 12\cdot663 :: 1142 : 14461$ feet the diſtance required, or 2·739 miles.

The ſame anſwered by Mr T Cock.

The ſide of the cone deſcribed by the ſtaff being 5 feet, and half the diameter of the baſe 3 feet, the altitude of the whole cone muſt be $\sqrt{5^2 - 3^2} = 4$, and that of the part deſcribed by the centre of oſcillation of the ſtaff $= \frac{8}{3}$. Then, by art. 217 of Simpſon's Fluxions, the time of one gyration of the ſtaff is $1\cdot108\sqrt{\frac{8}{3}} = 1\cdot809''$: therefore the diſtance of the cloud was $= 1\cdot809 \times 7 \times 1142 = 14461$ feet $= 2\frac{3}{4}$ miles, wanting 10 yards and 1 foot.

Ingenious ſolutions were alſo given by Meſſieurs *Adams*, *Amicus*, *Ball*, *Birch*, *Brown*, *Burrow*, *Campbell*, *Carliſle*, *Craggs*, *Croſbey*, *Cullyer*, *Dalton*, *Evans*, *Hornby*, *Howard*, *King*, *Mudge*, *Peace*, *Rowe*, *Simpſon*, *Stevenſon*, *Terry*, *White*, *Whitehouſe*, *and Williams*.

XII. Queſtion 889 *anſwered by Amicus.*

It is now pretty well known, that if $a =$ the leaſt but one of four numbers whoſe common difference is unity, their logarithms will be expreſſed by theſe four following ſeries:

$$\text{l.}\,(a-1) = \text{l.}\,a - m \times \cdot \frac{1}{a} + \frac{1}{2a^2} + \frac{1}{3a^3} + \frac{1}{4a^4} \;\&\text{c.}$$

$$\text{l.}\,(a) \qquad = \text{l.}\,a,$$

$$\text{l.}\,(a+1) = \text{l.}\,a + m \times \cdot \frac{1}{a} - \frac{1}{2a^2} + \frac{1}{3a^3} - \frac{1}{4a^4} \;\&\text{c.}$$

$$\text{l.}\,(a+2) = \text{l.}\,a + m \times \cdot \frac{2}{a} - \frac{4}{2a^2} + \frac{8}{3a^3} - \frac{16}{4a^4} \;\&\text{c.}$$

And the 3d difference of theſe four quantities

$$\text{is } m \times \cdot \frac{8-2}{3a^3} - \frac{16-4}{4a^4} + \frac{32-2}{5a^5} - \frac{64-4}{6a^6} + \frac{128-8}{7a^7} - \frac{256-4}{8a^8} \;\&\text{c.}$$

$$\text{or } m \times \cdot \frac{2}{a^3} - \frac{3}{a^4} + \frac{6}{a^5} - \frac{10}{a^6} + \frac{18}{a^7} - \frac{63}{2a^8} + \frac{170}{3a^9} - \frac{102}{a^{10}} \;\&\text{c.}$$

And if we ſuppoſe this to be a recurrent ſeries, and by the known method of ſubſtitution and compariſon, try to find ſuch a fraction as will produce it, it will be found that $\frac{4a+2}{2a^4+4a^3-2a-1}$ will by expanſion produce the firſt ſix terms of the ſeries, and that the 7th and 8th terms of this real recurrent ſeries will be $+\frac{56}{a^9} - \frac{99}{a^{10}}$ inſtead of $\frac{56\frac{2}{3}}{a^9} - \frac{102}{a^{10}}$, differing from them by $\frac{2}{3a^9} - \frac{3}{a^{10}}$, which, when $a = 100$, is $\frac{63\frac{2}{3}}{100^{10}} = \cdot 00000000000000000063\frac{2}{3}$; the fraction therefore gives the value of the ſeries true to 18 places of decimals, and is $= \frac{1}{pa^3 - \frac{1}{2}}$, as per queſtion.

The ſame anſwered by Lieutenant Wm Mudge, of the Royal Artillery.

If A, B, C, D, be any four numbers; then, becauſe the dif.

of the logs. of any two quantities is equal to the log. of their quotient, by dividing theſe numbers by each other, the quotients will be the ſeries of the firſt differences, and dividing the terms of the firſt differences will give the ſecond differences, and theſe divided again, give the 3d differences, and ſo on: hence the ſeveral orders of differences of the logs. of A, B, C, D, will be

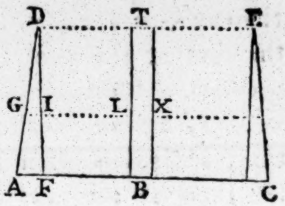
1ſt Dif.	2d Dif.	3d Dif.
l. $\frac{A}{B}$		
l. $\frac{B}{C}$	l. $\frac{B^2}{AC}$	l. $\frac{AC^3}{DB^3}$
l. $\frac{C}{D}$	l. $\frac{C^2}{BD}$	

So that the 3d dif. of the logs. is equal to the log. of $\frac{AC^3}{DB^3}$. Now, according to the queſtion, putting $a = C$, then is $A = a + 2$, $B = a + 1$, $C = a$, $D = a - 1$; and conſeq. $\frac{AC^3}{DB^3} = \frac{a+2}{a-1} \times \frac{a^3}{\overline{a+1}^3}$ $= \overline{a+2} \times \frac{a^3}{a^4 + 2a^3 - 2a - 1} = \frac{pa^3}{pa^3 - 1}$; and the log. $\frac{AC^3}{DB^3}$ or log. $\frac{pa^3}{pa^3 - 1}$ is $\frac{1}{pa^3} + \frac{1}{2p^2a^6} + \frac{1}{3p^3a^9}$ &c. the true 3d dif. of the logs. But this laſt ſeries, it is evident, is nearly $= \frac{1}{pa^3 - \frac{1}{2}}$, for by diviſion $\frac{1}{pa^3 - \frac{1}{2}} = \frac{1}{pa^3} + \frac{1}{2p^2a^6} + \frac{1}{4p^3a^9}$ &c. which differs from the former ſeries only in the 3d term, having 4 in the denominator of that term inſtead of 3, ſo that the dif. between the two is only $\frac{1}{12p^3a^9}$. And as $p = \frac{1}{2}$ nearly, theref. $p^3 = \frac{1}{8}$, and $12p^3 = \frac{3}{2}$ nearly; and ſo $\frac{1}{12p^3a^9} = \frac{2}{3a^9}$ nearly; which, when $a = 100$, will have 18 places of cyphers, and a 6 in the 19th place of decimals. Conſeq. $\frac{m}{pa^3 - \frac{1}{2}}$ gives the 3d dif. true to 18 places of decimals.

And the ſame method may be uſed for five or more numbers in arthmetical progreſſion.

This queſtion was alſo anſwered by the Rev. Mr *Hellins*, the propoſer.

XIV. Queſtion 891 *anſwered by Amicus.*



Let ACED repreſent the end of the ditches, TB the chink, whoſe breadth $LX = 24$ inches $= e$, $TB = 108 = a$, $AC = 384 = b$, $DE = 360 = c$, $f = 63360 = 1$ mile, $g = 386 =$ gravity. Then, if the water has no obſtruction in running off, its fluxion per ſecond with the firſt velocity (nearly) at $X = TX^{\frac{1}{2}}\,\dot{TX} \times e\sqrt{g}$, and through the whole length TB, $\frac{2}{3}TB^{\frac{3}{2}} \times e\sqrt{g}$, and when its depth is $BX = y$, $\frac{2}{3}eg^{\frac{1}{2}}y^{\frac{3}{2}}$. And as $DF = a : 2AF = b - c :: DI = a - y : 2GI$, and $\overline{2GI + DE} \times f =$ the area of the ſurface at $X = bf - nfy$, putting $n = \frac{b-c}{a}$; and the velocity of the deſcending ſurface $GX = \frac{e\sqrt{g}}{3f} \times \frac{y\sqrt{y}}{b - ny}$, which applied to $-\dot{y}$, gives the elementary time, whoſe correct fluent is $\frac{3f}{2\sqrt{g}} \times \overline{\frac{b}{\sqrt{y}} - \frac{b}{\sqrt{a}} + n\sqrt{y} - n\sqrt{a}} =$ the time; which, when $y = 1$, gives $139060'' = 38^{hs}\ 37'\ 40''$ the time required.

Solutions were alſo given by Meſſieurs *Rowe*, *Todd*, and *Williams*.—N. B. In this queſtion, the numbers for the dimenſions of the top and bottom of the ditch, were by miſtake changed; thereby making the ditch wideſt at the bottom, inſtead of the top. And it is to be noted alſo, that the above ſolution is given on the ſuppoſition that the velocity of iſſuing water, is equal to that acquired by a body in falling through only half the height of the ſurface above the orifice.

XV. *or* Prize Queſtion, *anſwered by Mr John Farey, of London.*

The figure deſigned by the equation $xy^2 = ax^3 + bx^2 + cx + d$ will have only one diameter if b^2 be either greater or leſs than $4ac$, which Mr *Stirling* has ſhewn in his *Lineæ Tertii Ordinis Newtonianæ*, prop. 16, alſo that $AD = \frac{-b}{2a}$, $Ad = A\delta = \frac{b}{2\sqrt{a}}$, and $Ab = \frac{4ad}{b^2 - 4ac}$ [*See the fig. to the ſame queſt. in the Diary*]; from the nature of equations it is evident that $\frac{-b}{2a}$ or AD is equal to half the ſum of the three roots; and by Mr *Sanderſon's* Lemma, at pag. 43 of the laſt Diary, if $-m$, $-n$, $-r$ be the three roots, and r be greater than $m+n-2\sqrt{mn}$, but leſs than $m+n+2\sqrt{mn}$, then b^2 will be leſs than $4ac$, and half the ſum of the roots, either equal to, or greater, than the greateſt. This being premiſed, we may obſerve that, in the 17, 18, 19 and 20th figures of Sir Iſaac Newton's Enumeration, b^2 is leſs than $4ac$, and A*t*, the greateſt of the roots, leſs than AD; it is evident alſo, from the above, that A*t* may be equal to, or greater, than AD; in which caſe the figure will be different from any of Newton's, as follows:

CASE 1. When, in the equation $ax^3+bx^2+cx+d=0$, b^2 is leſs than $4ac$, and the three roots real, unequal, and negative; and the greateſt A*t* greater than AD; then the hyperbola at D, having its vertex in *t*, will cut the aſymptote in C, and contain the part beyond within its own ſpace, as in the figure; and there will be an oval within the triangle. For example, let $xy^2=\frac{1}{4}x^3+4x^2+17x+20$ (where *a*, which may be any poſitive number, is aſſumed equal $\frac{1}{4}$, in order to have A*t* $=\frac{1}{2}$AD), and the three roots are Aτ $=-2$, A⅂ $=-4$, and A*d* $=-10$; alſo we have AD $=\frac{-b}{2a}=-8$, and AL $=\frac{4ad}{b^2-4ac}=-20$.

CASE 2. When the two leaſt roots are equal, the oval becomes a conjugate point. For example, if $xy^2=\frac{1}{4}x^3+4x^2+17\frac{1}{4}x+22\frac{1}{2}$, the roots are -3, -3, and -10; alſo AD $=-8$, and A*b* $=-18$.

CASE 3. When the two leaſt roots are impoſſible, the oval vaniſhes. For example, if $xy^2=\frac{1}{4}x^3+4x^2+18x+30$, the roots are $-3-\sqrt{-3}$, $-3+\sqrt{-3}$, and -10; alſo AD $=-8$, and A*b* $=-15$.

The two leaſt roots cannot here become equal, as in Newton's 18th figure; nor the three roots equal, as in the 19th figure. The ſame will alſo hold if A*t*, the greateſt root, be equal to AD, or when the vertex of the hyperbola is in D. Theſe three caſes ſhould be inſerted between the 16th and 17th figures of Newton's Enumeration.

Ingenious anſwers were alſo given by Meſſieurs Mudge and Sanders, &c.

FINIS.